



431316

Addendum No. 2d (NPDES)

for

Bay Harbor Development AE Report
December 29, 2009
Leachate Disposal Option Information

Little Traverse Bay CKD Release Site
Emmet County, Michigan



Gary L. Kelterborn
Project Coordinator

December 22, 2009

Mr. Daniel Dell, Chief
Permits Section
Michigan Department of Environmental Quality
Water Bureau
P.O. Box 30273
525 W. Allegan St., 2nd Floor
Lansing, MI 48909-7773

**RE: CMS Land Company Bay Harbor Development
NPDES Permit Application**

Dear Mr. Dell

Enclosed are two (2) copies of an NPDES Wastewater Discharge Permit Application for the CMS Land Company Bay Harbor Development site in Petoskey, Michigan. As you are aware, CMS is recovering groundwater that contains constituents of Cement Kiln Dust (CKD) that was land filled at the site. Currently the recovered groundwater is pretreated (pH adjustment) and trucked off-site for disposal.

Based on the results of two (2) pilot wastewater treatment studies, CMS believes it can effectively treat the contaminated groundwater for a direct surface water discharge to Little Traverse Bay. Preliminary results from the currently on-going pilot study indicate that coagulation/flocculation followed by ultrafiltration can remove 90% of the mercury, other heavy metals, and suspended solids present in the leachate. As such, CMS is submitting the NPDES application for your consideration. The application includes a request for variance (Rule 323.1103) for a number of parameters including mercury, vanadium and total dissolved solids. The packet contains, in order:

- Application Form (Section I – General Information & Section III – Industrial and Commercial Wastewater)
- Section I - Project Narrative
- Section I - Part 6 – Antidegradation Narrative
- Variance Request
- Section I - Part 10 – Water Flow Diagram and Narrative Description
- Section III – Part B.3 – Parameter Reporting Waiver Request
- Section III – Part 9.C. – Water Treatment Additive Narrative
- Location Maps/Figures (Appendix A)
- Previous Pilot Wastewater Treatment Study Report, Parsons Group, 2005 (Appendix B)
- Pilot Treatment System Flow Diagram & Floor Plan (Appendix C)
- KOCH Ultrafiltration Pilot System Information (Appendix D)
- Analytical Test Results & Results of Toxicity Tests (Appendix E)
- MDSD Forms (Appendix F)
- Photographs (Appendix G)

If you have any questions regarding this application please contact me at (517) 788-2482.

Sincerely,

A handwritten signature in black ink, appearing to read "G L Kelterborn". The signature is fluid and cursive, with the first name "G L" being more distinct than the last name "Kelterborn".

Gary L. Kelterborn
Director of Environmental Services

Cc: Michael C. Sniegowski, CMS Land

**Michigan Department of Environmental Quality
Water Bureau**

**NPDES
WASTEWATER DISCHARGE PERMIT
APPLICATION**

**CMS Land Company
Bay Harbor Development
Petoskey, Emmet County, Michigan**

Prepared by:



Environmental Consulting & Technology, Inc.
2200 Commonwealth Blvd., Suite 300
Ann Arbor, Michigan 48105
734-769-3004

December 22, 2009

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
 SECTION I - General Information

Section I shall be completed by all permit applicants. Instructions for completing Section I, Pages 1 and 2, are on Page 2 of the Appendix. To submit additional information, see Page ii, Item 3.

Water Bureau Use Only

Cashier Use Only: 37000-40535-9412-481000-00

Receipt #: _____

Permit ID #: _____

PLEASE TYPE OR PRINT

1	NPDES PERMIT NUMBER				
2. APPLICANT	Applicant Name CMS Land Company (CMS)				
	Address One Energy Plaza		Address 2 or P.O. Box		
	City Jackson	State Michigan	ZIP Code 49201		
	Telephone (with area code) (517) 788-0550	FAX (with area code)	Applicant Web Address www.cmsenergy.com		
3. FACILITY	Facility Name 1 CMS Bay Harbor Development				
	Facility Name 2				
	Facility Name 3				
	Street Address (do not use a P.O. Box Number) 5548 Charlevoix Avenue				
	City Petoskey	State Michigan	ZIP Code 49970		
4. CONTACTS	Telephone (with area code) N/A		FAX (with area code) N/A	Facility Web Address N/A	
	<input checked="" type="checkbox"/> Application Contact <input checked="" type="checkbox"/> Facility Contact <input checked="" type="checkbox"/> Discharge Monitoring Reports <input type="checkbox"/> Storm Water Billing <input type="checkbox"/> Biosolids Billing <input checked="" type="checkbox"/> NPDES Annual Billing	First Name Michael		Last Name Sniegowski	
		Title Vice President - CMS Land Co.		Business	
		Address 1 One Energy Plaza		Address 2	
		City Jackson		State Michigan	ZIP Code 49201
		Telephone (with area code) 517-768-7389		FAX (with area code)	e-mail address mcsniego@cmsenergy.com
		First Name		Last Name	
		Title		Business	
		Address 1		Address 2	
	City		State	ZIP Code	
	Telephone (with area code)		FAX (with area code)	e-mail address	
	<input type="checkbox"/> Application Contact <input type="checkbox"/> Facility Contact <input type="checkbox"/> Discharge Monitoring Reports <input type="checkbox"/> Storm Water Billing <input type="checkbox"/> Biosolids Billing <input type="checkbox"/> NPDES Annual Billing	First Name		Last Name	
		Title		Business	
		Address 1		Address 2	
		City		State	ZIP Code
Telephone (with area code)		FAX (with area code)	e-mail address		
First Name		Last Name			
Title		Business			
Address 1		Address 2			
City		State	ZIP Code		
Telephone (with area code)		FAX (with area code)	e-mail address		

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME CMS Bay Harbor Development	NPDES PERMIT NUMBER
---	---------------------

5. PERMIT ACTION REQUESTED (Check one box only) - Instructions for this item are on Page 2 of the Appendix.

- ☐ **NEW USE:** A proposed discharge.
- ☒ **EXISTING DISCHARGE** that is currently unpermitted.
- ☐ **REISSUANCE** of current permit.
- ☐ **MODIFICATION** of current permit. Attach a description of the proposed modification.

Note: Applications for **New Use** discharges, **Existing Discharges** that are currently unpermitted, and for either **Reissuance** or **Modification** that include an increased loading of pollutants to the receiving water are required to submit a Rule 98 Demonstration with the Application. See Item 6.

6. RULE 98 - ANTIDegradation REQUIREMENTS - Instructions for this item are on Page 2 of the Appendix.

In accordance with Rule 323.1098 of the Michigan Water Quality Standards, the applicant is required to submit an Antidegradation Demonstration for any new or increased loading of pollutants to the surface waters of the state. An Antidegradation Demonstration must contain the information specified in Rule 1098, outlined in the Antidegradation section of the Appendix. For assistance in completing this item, contact the Permits Section.

Will this discharge be an increased loading of pollutants to the surface waters of the state? ☐ Yes, continue below. ☒ No.

- ☐ Antidegradation Demonstration provided. ☒ Increased loading of pollutants is exempt from Antidegradation Demonstration as indicated below:
- ☐ A short-term (weeks to months) or temporary lowering of water quality.
 - ☐ Bypasses that are not prohibited by regulations set forth in 40 CFR §122.41(m).
 - ☒ Response actions undertaken to alleviate a release of pollutants into the environment that may pose an imminent and substantial danger to the public health or welfare.
 - ☒ Discharges of pollutant quantities from the intake water at a facility if the intake and discharge are to the same body of water.
 - ☐ Increases in flow, if the increase is within the design flow of the facility, it is not specifically authorized in the current permit, and there is no significant change expected in the characteristics of the wastewater collected.
 - ☐ Intermittent increased loading related to wet-weather conditions.
 - ☐ New or increased loading due to MDEQ-approved controls related to wet-weather conditions.
 - ☐ Discharges authorized by Certificates of Coverage and Notices of Coverage.
 - ☐ Increased loadings within the authorized levels of a limit in an existing control document, except those loadings that result from actions by the permittee that would otherwise require submittal of an increased use request.
 - ☐ Increased loadings of a pollutant which do not involve Bioaccumulative Chemicals of Concern (BCC) and which use less than 10 percent of the unused loading capacity that exists at the time of the request.

7. ADDITIONAL FACILITY LOCATION INFORMATION - Instructions for this item are on Page 2 of the Appendix.

A Local Unit of Government (LUG) Petoskey				LUG e-mail address ddewitt@ci.petoskey.mi.us	
B County Emmet County				Township Resort Township	
C. Town T34N	Range R6W	Section 2 - 10	1/4	1/4, 1/4	Private (French) Land Claim
D. Latitude 45.368				Longitude -85.018	

8. CERTIFIED OPERATOR

Does the facility have an MDEQ-certified operator? ☒ Yes ☐ No

Instructions for this item are

on Page 2 of the Appendix.

First Name Jason		Last Name Iseler			
Certification Number Notified verbally passed exam - no cert # yet		Certification Classification(s) B - 1b			
Address 1 5548 Charlevoix Avenue		Address 2			
City Petoskey		State Michigan		Zip Code 49970	
Telephone Number		Fax Number		e-mail address	

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME

CMS Bay Harbor Development

NPDES PERMIT NUMBER

9. OTHER ENVIRONMENTAL PERMITS

Provide the information requested below for any other federal, state, or local environmental permits in effect or applied for at the time of submittal of this Application Form, including, but not limited to, permits issued under any of the following programs: Air Pollution Control, Hazardous Waste Management, Wetlands Protection, Soil Erosion and Sedimentation Control, and other NPDES permits. To submit additional information, see Page ii, Item 3.

Issuing Agency	Permit or COC Number	Permit Type
N/A		

10. WATER FLOW DIAGRAM AND NARRATIVE DESCRIPTION

Provide a flow diagram (**using 8½" x 11" paper if possible**) showing the wastewater flow through the facility (from intake through discharge), including all processes, treatment units including any lagoons or ponds used for wastewater treatment or storage (identify treatment units that operate intermittently), and bypass piping, and include a narrative description that explains the diagram. Show all operations contributing wastewater and the locations of flow meters, chemical feeds, and monitoring and discharge points. The water balance shall show the daily average flow rates at the intake and discharge points, and approximate daily flow rates between treatment units, including influent and treatment rates. Use actual measurements whenever available, otherwise use the best estimate. Show all significant losses of water to products, atmosphere, and discharge. In addition, provide a flow diagram for any storm water discharges from secondary structures that are required by state or federal law, and for storm water runoff from any Site of Environmental Contamination, pursuant to Part 201 of the Michigan Act. **Do not send blueprints.**

Municipal Facilities - Include a narrative that briefly describes the history of the wastewater treatment facility and collection system, including the initial construction, the facility improvements that have been made, future plans for upgrade, the location of all constructed emergency overflows, and other pertinent information.

Industrial and Commercial Facilities - The line diagram shall include all operations contributing wastewater, including process and production areas, sanitary flows, cooling water, and storm water runoff. **Also include a narrative** that provides a brief description of the nature of the business and the manufacturing processes.

ATTACH THIS INFORMATION TO THIS APPLICATION. PLEASE DO NOT BIND THIS INFORMATION.

11. MAP OF FACILITY AND DISCHARGE LOCATION

Provide a detailed map on 8½" x 11" paper showing the location of the existing or proposed facility, wastewater and biosolid treatment system(s), and wastewater monitoring and discharge points into receiving waters (including bypasses). Include the exact location of the wastewater monitoring and discharge point(s) and all areas through which the discharge flows (e.g., wetlands, open drains, storm sewers), if applicable, between the discharge point and the receiving water. If the discharge is to a storm sewer, label the storm sewer and show its flow path to the receiving water. Also include the location of any water supply intakes or wells, and groundwater monitoring wells. This map shall be a United States Geological Survey quadrangle (7.5 minute series) or other map of comparable detail, scale, and quality (which shows surface water bodies, roads, bathing beaches, and other pertinent landmarks). **It is preferred that the minimum area this map shall encompass is approximately one mile beyond the property boundaries.**

ATTACH THIS INFORMATION TO THIS APPLICATION.

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
 SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME CMS Bay Harbor Development	NPDES PERMIT NUMBER
---	---------------------

12. CONTRACT LABORATORIES THAT PROVIDE ANALYTICAL SUPPORT
 Provide the name and address of each contract laboratory or consulting firm that performed any analyses submitted as part of this Application. To submit additional information, see Page ii, Item 3.

Laboratory Name TriMatrix			Laboratory Name Great Lakes Environmental Center		
Street Address 5560 Corporate Exchange Court			Street Address 739 Hastings Street		
City Grand Rapids	State Michigan	ZIP Code 49512-5503	City Traverse City	State Michigan	ZIP Code 49696
Telephone (with area code) 616-975-4450		Fax (with area code) 616-942-7463		Telephone (with area code) 231-941-2230	
				Fax (with area code) 231-941-2240	
Analysis Performed all analysis except "field pH", Temp., Conductivity			Analysis Performed Acute Toxicity Testing		
Laboratory Name			Laboratory Name		
Street Address			Street Address		
City	State	City	State	City	State
Telephone (with area code)		Fax (with area code)		Telephone (with area code)	
				Fax (with area code)	
Analysis Performed			Analysis Performed		

13. LIST ADJACENT PROPERTY OWNERS
 List the names and mailing addresses of all property owners for all properties adjacent to the facility, treatment systems, and discharge locations. For vacant lots or empty buildings, supply the owner's mailing address – NOT the lot or building property address. To submit additional information, see Page ii, Item 3.

Name	Address	City	State	ZIP Code
Golf Sites, LLC	4000 Main Street	Petoskey	MI	49770
Boyne Resorts	1 Boyne Mountain Road	Boyne Falls	MI	49770
Bay Harbor Company, LLC	4000 Main Street	Petoskey	MI	49770
City of Petoskey	101 East Lake Street	Petoskey	MI	49770
Golf Sites, LLC	4000 Main Street	Petoskey	MI	49770

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME

CMS Bay Harbor Development

NPDES PERMIT NUMBER

14. APPLICATION CERTIFICATION

Rule 323.2114(1-4), promulgated under the Michigan Act, requires that this Application must be signed as follows:

- A. For an organization, company, corporation, or authority, by a principal executive office, vice president, or higher.
- B. For a partnership, by a general partner.
- C. For a sole proprietor, by the proprietor.
- D. For a municipal, state, or other public facility, by a principal executive officer or ranking elected official (such as the mayor, village president, city or village manager, or clerk).

Note: If the signatory is not listed above, but is authorized to sign the Application, please provide documentation of that authorization.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for having knowledge of violations."

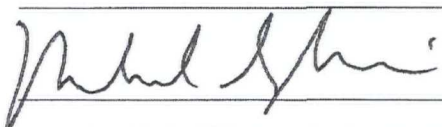
The last application for this facility was submitted on: _____

I understand that my signature constitutes a legal agreement to comply with the requirements of the NPDES Permit. I certify under penalty of law that I possess full authority on behalf of the legal owner/permittee to sign and submit this application.

Print Name: Michael Sniegowski

Vice President

Title: _____

Signature: 

December 22, 2009

Date: _____

This completes Section I. Publicly-Owned Treatment Works (POTWs) discharging sanitary and industrial wastewater to the surface waters, and privately-owned treatment works discharging sanitary wastewater to the surface waters should complete Section II. Privately-owned treatment works include, but are not limited to, Mobile Home Parks, Campgrounds, Condominiums, Hotels and Motels, Nursing Homes, etc. All other applicants should complete Section III. If assistance is needed to complete this Application, contact the Permits Section.

Permit Application Submittal Checklist

Please confirm the following before submitting the Application Form:

- ☒ 1. Section I has been completed, including all diagrams, maps, and the treatment process narrative.
- ☒ 2. The Application has been signed as required above in Section I.14. (A.-D.) or a copy of the letter authorizing the signatory to sign the letter has been included, as appropriate.
- ☒ 3. Section II or Section III has been completed, including any additional information or submissions.
- ☐ 4. Section IV has been completed by any facility that discharges storm water.
- ☐ 5. Section V has been completed by any facility that is a Concentrated Animal Feeding Operation (CAFO).
- ☒ 6. A check or Money Order for the appropriate Application Fee has been made out to the "State of Michigan" and has been included with the Application submittal.

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION III - Industrial and Commercial Wastewater

Section III is to be completed by all facilities classified as Industrial or Commercial facilities. Industrial and Commercial facilities include, but are not limited to, facilities that discharge or propose to discharge a wastewater generated by a production process, a service provided, or through a remediation project. Municipal and public facilities are not required to complete Section III (unless requesting authorization for discharges other than sanitary wastewater).

A. Facility Information

PLEASE TYPE OR PRINT

FACILITY NAME CMS Bay Harbor Development	NPDES PERMIT NUMBER
---	---------------------

1. BUSINESS INFORMATION

☐ No Change From Last Application

A. Provide up to four Standard Industrial Classification (SIC) or North American Industry Classification System (NAICS) codes, in order of economic importance, which best describe the major products or services provided by this facility.

1. NAICS 56221-HAZ WWTP	2. NAICS 562910-SiteRem	3. NAICS 562219-NonHaz	4.
-------------------------	-------------------------	------------------------	----

B. Indicate if this facility is a primary industry (refer to Table 1 of the Appendix to determine if this facility is a primary industry).

☐ Yes. This facility is a primary industry. Indicate the primary industry as identified in Table 1 of the Appendix: _____

☒ No. This facility is not a primary industry.

C. Is this facility a Concentrated Animal Feeding Operation (CAFO)?

☐ Yes. Continue with Section III.B.11.

☒ No.

2. WATER SUPPLY AND DISCHARGE TYPE

☐ No Change From Last Application

A. Identify all water sources entering the facility and treatment systems, and provide average flows. The volume may be estimated from water supply meter readings, pump capacities, etc. Provide the name of the source where appropriate (i.e., Grand River, Lake Michigan, City of Millpond). To submit additional information, see Page ii, Item 3.

Name and Location of Source	Average Volume or Flow Rate	Units
Municipal Supply		
Surface Water Intake		
Private Well		
Other: <u>X</u>	Recovered Contam. Ground Water Seepage	0.19 MGD

B. Identify water discharged by the facility and treatment systems, and provide average flows. If water is first used for one purpose and then is subsequently used for another purpose, indicate the type and amount of the last use. For example, if water is initially used for noncontact cooling water and then for process water, indicate the amount of process water. The amount of water from sources should approximate the amount of water usage. If they are different, provide an explanation.

Average Flow Rate	Units
Process Wastewater	
Contact Cooling Water	
Noncontact Cooling Water	
Groundwater Cleanup	0.19 mgd

Average Flow Rate	Units
Sanitary Wastewater	
Regulated Storm Water	
High Pressure Test Water	
Other: _____	

Note: For A and B above, indicate units as MGD (million gallons per day), MGY (million gallons per year), GPD (gallons per day), or other appropriate unit.

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

Complete a separate Section III.B. - Outfall Information (Pages 19-24) - for each outfall at the facility. Make copies of this blank section of the Application as necessary for additional outfalls.

PLEASE TYPE OR PRINT

FACILITY NAME CMS Bay Harbor Development				NPDES PERMIT NUMBER		OUTFALL NUMBER	
---	--	--	--	---------------------	--	----------------	--

1. OUTFALL INFORMATION - Instructions for this item are on Page 3 of the Appendix. ☐ No Change From Last Application, Items A. – D.

A. Receiving Water Little Traverse Bay				Hydrologic Unit Code (HUC) 04060105		
B. County Emmet				Township Resort Township		
C. Town T34N	Range R6W	Section 	¼	¼, ¼	Private (French) Land Claim)	
D. Latitude N 45 deg 22 min 11 sec				Longitude W 85 deg 0 min 19 sec		

E. Type of Wastewater Discharged (check all that apply to this outfall): ☐ No Change From Last Application, Item E.

<input type="checkbox"/> Contact Cooling	<input checked="" type="checkbox"/> Groundwater Cleanup	<input type="checkbox"/> Hydrostatic Pressure Test	<input type="checkbox"/> Noncontact Cooling Water
<input type="checkbox"/> Process Wastewater	<input type="checkbox"/> Sanitary Wastewater	<input type="checkbox"/> Storm Water - not regulated	<input type="checkbox"/> Storm Water - regulated
<input type="checkbox"/> Storm water subject to effluent guidelines (indicate under which category): _____			
<input type="checkbox"/> Other – specify (see "Table 8 - Other Common Types of Wastewater" - in the Appendix) _____			

F. What is the Maximum Design Flow Rate for this outfall: 0.19 MGD ☐ No Change From Last Application, Items F. – G.

G. What is the Maximum Authorized Discharge Flow for this outfall for the next five years?
Seasonal Dischargers _____ MGY (Continue with Item H).
Continuous Dischargers 0.19 MGD (Continue with Item I).

H. Seasonal Discharge:
List the discharge periods (by month) and the volume discharged in the space provided below.

From	Through	Actual Discharge Volume (MGD)	Annual Total
From	Through	Actual Discharge Volume (MGD)	
From	Through	Actual Discharge Volume (MGD)	
From	Through	Actual Discharge Volume (MGD)	

I. Continuous Discharge:
How often is there a discharge from this outfall (on average)? 24 Hours/Day 365 Days/Year

Batch dischargers are required to provide the following additional information:

Is there effluent flow equalization? ☐ Yes ☐ No

Batch Peak Flow Rate: _____ Number of batches discharged per day: _____

	Minimum	Average	Maximum
Batch Volume (gallons)			
Batch Duration (minutes)			

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

USE TYPE OR PRINT

FACILITY NAME CMS Bay Harbor Development	NPDES PERMIT NUMBER	OUTFALL NUMBER
---	---------------------	----------------

2. PROCESS STREAMS CONTRIBUTING TO OUTFALL DISCHARGE ☐ No Change From Last Application

Federal regulations require that different industries report different information, depending on the type of facility. The information below is used to determine the applicable federal regulations for this facility. An abbreviated list is in the Summary of Information to be reported by Industry Type section of the Appendix. Applicants are required to provide the name and the SIC or the NAICS code for each process at the facility. Facilities with production-based limits must report an estimated annual production rate for the next five years, or the life of the permit. If the wastestream is not regulated under federal categorical standards, the applicant is required to report all pollutants which have the reasonable potential to be present in the discharge. To submit additional information, see Page ii, Item 3.

PROCESS INFORMATION

A. Name of the process contributing to the discharge: Groundwater seepage

B. SIC or NAICS code: 562910

C. Describe the process and provide measures of production:

See Section I - Project Narrative

PROCESS INFORMATION

A. Name of the process contributing to the discharge: _____

B. SIC or NAICS code: _____

C. Describe the process and provide measures of production:

PROCESS INFORMATION

A. Name of the process contributing to the discharge: _____

B. SIC or NAICS code: _____

C. Describe the process and provide measures of production:

PROCESS INFORMATION

A. Name of the process contributing to the discharge: _____

B. SIC or NAICS code: _____

C. Describe the process and provide measures of production:

PROCESS INFORMATION

A. Name of the process contributing to the discharge: _____

B. SIC or NAICS code: _____

C. Describe the process and provide measures of production:

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
 SECTION III - Industrial and Commercial Wastewater
 B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME CMS Bay Harbor Development	NPDES PERMIT NUMBER	OUTFALL NUMBER
---	---------------------	----------------

3. EFFLUENT CHARACTERISTICS - CONVENTIONAL POLLUTANTS - Instructions for this item are on Page 4 of the Appendix.

☐ Check this box if additional information is included as an attachment. To submit additional information, see Page ii, Item 3.

Please Note: Rule 323.1062 allows the use of either *Escherichia Coli* or Fecal Coliform Bacteria as an indicator that effluent has been disinfected. The MDEQ will use the indicator selected below in the permit issued based on this Application. ☐ Use *Escherichia Coli* as an indicator of disinfection. ☐ Use Fecal Coliform Bacteria as an indicator of disinfection.

Submitted via DMR's	Waiver Request and the Rationale Behind the Request	Parameter	Maximum Monthly Concentration	Maximum Daily Concentration	Units	Number of Analyses	Sample Type
<input type="checkbox"/>		Biochemical Oxygen Demand – five day (BOD ₅)	13	13	mg/l	3	<input checked="" type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>		Chemical Oxygen Demand (COD)	130	130	mg/l	3	<input checked="" type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>		Total Organic Carbon (TOC)	43	43	mg/l	3	<input checked="" type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>		Ammonia Nitrogen (as N)	-	-	mg/l	-	<input checked="" type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>		Total Suspended Solids	6.1	6.1	mg/l	3	<input checked="" type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>	NA	Total Dissolved Solids	7,740	7,740	mg/l	3	<input checked="" type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>	NA	Total Phosphorus (as P)	-	-	mg/l	-	<input checked="" type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>	NA	Fecal Coliform Bacteria (report geometric means)		Maximum-7day -	counts/100ml	-	Grab
<input type="checkbox"/>	NA	<i>Escherichia Coli</i> (report geometric means)		Maximum-7day -	counts/100 ml	-	Grab
<input type="checkbox"/>	NA	Total Residual Chlorine		-	<input type="checkbox"/> mg/l <input type="checkbox"/> µg/l	-	Grab
<input type="checkbox"/>	NA	Dissolved Oxygen	Do Not Use	Minimum daily 4.84	mg/l		<input type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>		pH (report maximum and minimum of individual samples)	Minimum 7.93	Maximum 8.26	standard units		<input type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>		Temperature, Summer	-	-	<input type="checkbox"/> °F <input type="checkbox"/> °C		<input type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>		Temperature, Winter	31	31	<input type="checkbox"/> °F <input checked="" type="checkbox"/> °C		<input type="checkbox"/> Grab <input type="checkbox"/> 24 Hr Comp
<input type="checkbox"/>	NA	Oil & Grease			mg/l	-	Grab

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

CASE TYPE OR PRINT

FACILITY NAME

CMS Bay Harbor Development

NPDES PERMIT NUMBER

OUTFALL NUMBER

Note: For questions on this page, Tables 1-5 are found in the Appendix.

4. PRIMARY INDUSTRY PRIORITY POLLUTANT INFORMATION

Existing primary industries that discharge process wastewater are required to submit the results of at least one permittee-collected effluent analysis for selected organic pollutants identified in Table 2 (as determined from Table 1, Testing Requirements for Organic Toxic Pollutants by Industrial Category), and all of the pollutants identified in Table 3. Existing primary industries are required to also provide the results of at least one permittee-collected effluent analysis for any other chemical listed in Table 2 known or believed to be present in the facility's effluent.

In addition, submit the results of all other effluent analyses performed within the last three years for any chemical listed in Tables 2 and 3.

New primary industries that propose to discharge process wastewater are required to provide an estimated effluent concentration for any chemical listed in Tables 2 and 3 expected to be present in the facility's effluent.

5. DIOXIN AND FURAN CONGENER INFORMATION

Existing industries that use or manufacture 2,3,5-trichlorophenoxy acetic acid (2,4,5-T); 2-(2,3,5-trichlorophenoxy) propanoic acid, (Silvex, 2,3,5-TP); 2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate (Erbon); 0,0-dimethyl 0-(2,4,5-trichlorophenyl) phosphorothionate (Ronnell); 2,4,5-trichlorophenol (TCP); or hexachlorophrene (HCP), or knows or has reason to believe that 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is present in the facility's effluent, are required to submit the results of at least one effluent analysis for the dioxin and furan congeners listed in Table 6. All effluent analyses for dioxin and furan congeners shall be conducted using USEPA Method 1613.

In addition, submit the results of all other effluent analyses performed within the last three years for any dioxin and furan congener listed in Table 6.

New industries that expect to use or manufacture 2,3,5-trichlorophenoxy acetic acid (2,4,5-T); 2-(2,3,5-trichlorophenoxy) propanoic acid (Silvex, 2,3,5-TP); 2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate (Erbon); 0,0-dimethyl 0-(2,4,5-trichlorophenyl) phosphorothionate (Ronnell); 2,4,5-trichlorophenol (TCP); or hexachlorophrene (HCP), or knows or has reason to believe that 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is present in the facility's effluent, shall provide estimated effluent concentrations for the dioxin and furan congeners listed in Table 6.

OTHER INDUSTRY PRIORITY POLLUTANT INFORMATION

Existing secondary industries, or existing primary industries that discharge nonprocess wastewater, are required to submit the results of at least one effluent analysis for any chemical listed in Tables 2 and 3 known or believed to be present in the facility's effluent.

In addition, submit the results of all other effluent analyses performed within the last three years for any chemical listed in Tables 2 and 3.

New secondary industries, or new primary industries that propose to discharge nonprocess wastewater, are required to provide an estimated effluent concentration for any chemical listed in Tables 2 and 3 expected to be present in the facility's effluent.

7. ADDITIONAL TOXIC AND OTHER POLLUTANT INFORMATION

All existing industries, regardless of discharge type, are required to provide the results of at least one analysis for any chemical listed in Table 4 known or believed to be present in the facility's effluent, and a measured or estimated effluent concentration for any chemical listed in Table 5 known or believed to be present in the facility's effluent. In addition, submit the results of any effluent analysis performed within the last three years for any chemical listed in Tables 4 and 5.

New industries, regardless of discharge type, are required to provide an estimated effluent concentration for any chemical listed in Tables 4 and 5 expected to be present in the facility's effluent.

8. INJURIOUS CHEMICALS NOT PREVIOUSLY REPORTED

New or existing industries, regardless of discharge type, are required to provide a measured or estimated effluent concentration for any toxic or otherwise injurious chemicals known or believed to be present in the facility's effluent that have not been previously identified in this Application. Quantitative effluent data for these chemicals that is less than five years old shall be reported.

NOTE: All effluent data submitted in response to questions 4, 5, 6, 7, and 8 above should be recorded on Page 23. To submit additional information, see Page ii, Item 3. If the effluent concentrations are estimated, place an "E" in the "Analytical Method" column. The following fields shall be completed for each data row: Parameter, CAS No., Concentration(s), Sample Type, and Analytical Method. For analytical test requirements, see Page ii, Item 5.

If Alternate Test Procedures have been approved for any parameter listed above (Items 4 through 8), see Page ii, Item 5 for additional instructions.

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
 SECTION III - Industrial and Commercial Wastewater
 B. Outfall Information

 CASE TYPE OR PRINT

FACILITY NAME CMS Bay Harbor Development			NPDES PERMIT NUMBER				OUTFALL NUMBER	
Submitted via DMR's	PARAMETER	SAMPLE DATE → CAS No.	11/5/09	11/9/09	11/10/09		Sample Type	Analytical Method
			Conc. (µg/l)	Conc. (µg/l)	Conc. (µg/l)	Conc. (µg/l)		
<input type="checkbox"/>	Aluminum	7429-90-5	860	820	700			
<input type="checkbox"/>	Antimony	7440-36-0	<1.0	<1.0	<1.0			
<input type="checkbox"/>	Arsenic	7440-38-2	27	26	30			
<input type="checkbox"/>	Barium	7440-39-3	29	31	49			
<input type="checkbox"/>	Beryllium	7440-41-7	<1.0	<1.0	<1.0			
<input type="checkbox"/>	Boron	7440-42-8	80	86	90			
<input type="checkbox"/>	Cadmium	7440-43-9	<0.20	<0.20	<0.20			
<input type="checkbox"/>	Chromium, Total	7440-47-3	6.6	5.5	5.5			
<input type="checkbox"/>	Copper	7440-50-8	9.2	7.4	14			
<input type="checkbox"/>	Iron	7439-89-6	<20	<20	30			
<input type="checkbox"/>	Lead	7439-92-1	<1.0	<1.0	<1.0			
<input type="checkbox"/>	Mercury	7439-97-6	0.00238	0.00432	0.00491			
<input type="checkbox"/>	Manganese	7439-96-5	<20	<20	<20			
<input type="checkbox"/>	Molybdenum	7439-98-7	97	99	110			
<input type="checkbox"/>	Nickel	7440-02-0	15	18	25			
<input type="checkbox"/>	Selenium	7782-49-2	19	14	19			
<input type="checkbox"/>	Silicon	7440-21-3	8800	6200	6500			
<input type="checkbox"/>	Silver	7440-22-4	<0.20	<0.20	<0.20			
<input type="checkbox"/>	Strontium	7440-24-6	130	110	110			
<input type="checkbox"/>	Thallium	7440-28-0	<1.0	<1.0	<1.0			
<input type="checkbox"/>	Vanadium	7440-62-2	32	32	35			
<input type="checkbox"/>	Zinc	7440-66-6	21	27	26			
<input type="checkbox"/>								
<input type="checkbox"/>								
<input type="checkbox"/>								
<input type="checkbox"/>								
<input type="checkbox"/>								

Michigan Department of Environmental Quality- Water Bureau
WASTEWATER DISCHARGE PERMIT APPLICATION
SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

CASE TYPE OR PRINT

FACILITY NAME

CMS Bay Harbor Development

NPDES PERMIT NUMBER

OUTFALL NUMBER

9. WATER TREATMENT ADDITIVES

Water treatment additives include any material that is added to water used at the facility or to wastewater generated by the facility to condition or treat the water.

Approvals of water treatment additives are authorized by the MDEQ under separate correspondence. The issuance of an NPDES permit does not constitute approval of the water treatment additives that are included in this Application.

A. Are there water treatment additives in the discharge from this facility?

☒ Yes.

☐ No. Proceed to Item 10.

B. Have these water treatment additives been previously approved?

☒ Yes. Submit a list of the previously-approved water treatment additives and the date on which they were approved. The information listed in Item C., Items 1-8 shall be updated if it has changed since the previous approval.

☐ No. Continue with Item C.

C. Submit a list of water treatment additives that are or may be discharged from the facility. Applicants are required to submit the information listed below for each additive.

1. The water treatment additive Material Safety Data Sheet
2. The proposed water treatment additive discharge concentration
3. The discharge frequency (i.e., number of hours per day, week, etc.)
4. The outfall from which the water treatment additive is to be discharged
5. The type of removal treatment, if any, that the water treatment additive receives prior to discharge
6. The water treatment additive function (i.e., microbiocide, flocculant, etc.)
7. A 48-hour LC50 or EC50 for a North American freshwater planktonic crustacean (either *Ceriodaphnia* sp., *Daphnia* sp., or *Simocephalus* sp.)
8. The results of a toxicity test for one other North American freshwater aquatic species (other than a planktonic crustacean) that meets a minimum requirement of Rule 323.1057(2)(a) of the Water Quality Standards. Examples of tests that would meet this requirement include a 96-hour LC50 for rainbow trout, bluegill, or fathead minnow.

The required toxicity information (described in Items 7 and 8 above) is currently available in the Water Bureau files for the water treatment additives listed on the MDEQ's Internet page. To access that information, go to <http://www.michigan.gov/deq>, click on "Site Map," at the bottom of the right column under **Water Quality Monitoring**, click on "Assessment of Michigan Waters." Under the **Information** heading, click on the "Water Treatment Additive List." If you intend to use one of the water treatment additives on this list, only the information in Items 1 through 6 above needs to be submitted to the Water Bureau.

Note: The availability of toxicity information for a water treatment additive does not constitute approval to discharge the water treatment additive.

10. WHOLE EFFLUENT TOXICITY (WET) TESTS

Have any acute or chronic WET tests been conducted on any discharges or receiving water(s) in relation to facility discharges within the last three years? If yes, identify the tests and summarize the results on a separate sheet, unless the test has been submitted to the MDEQ in the last three years. For assistance with WET testing, see "Whole Effluent Toxicity Test Guidance and Requirements" in the Appendix. Yes.

11. CONCENTRATED ANIMAL FEEDING OPERATION (CAFO) INFORMATION. (See Section V – Concentrated Animal Feeding Operations.) To be completed by CAFOs only. For additional information, see "CAFO Guidance and Requirements" in the Appendix.

This completes Section III. Return the completed Application (Sections I, III, IV, and V, and any attachments) to one of the addresses on Page ii of this Application. If assistance is needed to complete this Application, contact the Permits Section.

CMS Bay Harbor Development
NPDES Permit Application
Section I – Project Narrative

The Bay Harbor Development Site (Development) is located five (5) miles west of Petoskey in Resort Township, Emmet County, Michigan. Maps of the Development are provided in Appendix A.

The site was previously a limestone quarry operation and a cement plant for over 100 years. The operations ceased in the 1980's leaving a legacy of over 2.5 million cubic yards of cement kiln dust (CKD) on the plant site and in the adjacent quarry, as well as seepage of high pH CKD contaminated groundwater (seep water) into Little Traverse Bay.

Consumers Land Company (CMS) began remediation of the site in the mid 1990's. The CKD deposits were contoured and covered with overburden to establish turf for use as a golf course. Currently, portions of the seep water are collected by subsurface drainage systems. The seep water is caustic ($\text{pH} > 12$), contains significant levels of total dissolved solids, and heavy metals, including vanadium and mercury, due to groundwater movement in and around the CKD.

The collected seep water is pumped to the Bay Harbor Development Pretreatment Facility to adjust the pH of the CKD leachate. The treated leachate is neutralized with concentrated sulfuric acid and is then either transported off-site to a deep well injection location (near Gaylord, Michigan) or to the Grand Traverse County Septage Treatment System which discharges to the Traverse City Waste Water Treatment Plant.

In 2005, CMS completed a pilot scale wastewater treatment study (conducted by Parsons Group), over a six-week period. The primary purpose of the pilot was to demonstrate that the leachate could be effectively treated and discharged to the Petoskey WWTP and/or Little Traverse Bay. A copy of this study is included in Appendix B. The pilot defined the optimum treatment system and the optimum operating conditions of the system. The study concluded that the optimum treatment for the removal of trace metals, including mercury from the leachate, is:

- pH adjustment by adding sulfuric acid (98%) for lowering pH to less than 9.
- Addition of alum and metal precipitate to precipitate/co-precipitate mercury and other metals.
- Ultrafiltration.

CMS has contracted with Environmental Consulting & Technology, Inc (ECT) to conduct an additional Pilot Treatment Study at the Bay Harbor Development on the collected leachate. This pilot study is using the technology and operating conditions determined as optimum during the Parson's study. The additional study is needed because of changes to the volume and quality of the seep water. A new waste stream,

TLC (targeted leachate collection), is now being collected and treated and also there have been changes in the water collected in Seep 1, Seep 2 (+ West CKD) and Edge Drain. The locations of these collection systems are given in Appendix A.

This currently on-going pilot study is finding that coagulation/flocculation followed by ultrafiltration can remove over 90% of the mercury, other heavy metals, and suspended solids present in the leachate. Based on the results of these pilot studies, CMS is proposing that a permanent WWTP be designed and built to treat the leachate with the discharge ultimately flowing to Little Traverse Bay. The proposed WWTP and discharge location is shown in Appendix A and a schematic of the pilot WWTP, as well as flow diagrams of two (2) options (batch and continuous operation) for a full-scale treatment system are included in Appendix C.

Bay Harbor Resort – Development Area
NPDES Permit Application
Section I – Part 6 – Antidegradation

Summary Of Facts

The Bay Harbor site was a limestone quarry operation and a cement plant site for over 100 years. The operations ceased in the 1980s, leaving a legacy of more than 2.5 million cubic yards of cement kiln dust (CKD) on the plant site and in the adjacent quarry. As a result of disposal practices on the site by parties unrelated to permit applicant CMS Land Company (CMS), groundwater has come in contact with CKD at the site, forming a high pH leachate. This impacted groundwater or high pH leachate has then discharged into the Little Traverse Bay of Lake Michigan (the Bay) for many years.

Beginning in 2004, the flow of high pH leachate to the Bay prompted the United States Environmental Protection Agency (EPA) to exercise its authority over Bay Harbor pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601 *et seq.* In February 2005, CMS voluntarily entered into an administrative order on consent (AOC) under CERCLA with EPA.

The AOC requires that CMS conduct a series of response activities at Bay Harbor, including the Development Area. At the Development, CMS has removed a portion of the CKD, contoured and covered portions of the CKD, and developed groundwater intercept and targeted leachate collection systems to eliminate the direct discharge of a large percentage of this high pH leachate to the Bay.

When CMS collects leachate at the Development, it chemically adjusts the pH of the leachate before having it trucked to an offsite deep injection well or to a publicly owned wastewater treatment plant in a different community. The costs of collecting, treating, and disposing of approximately 190,000 gallons of leachate per day at the Development is significant, and this cost will continue for years to come. Trucking also poses environmental tradeoffs from emissions and fuel use, as well as the risk of transportation-related accidents.

CMS is proposing in this NPDES permit application to treat the intercepted leachate (190,000 gal/d max.) for pH, and flocculate and precipitate metals from the waste stream, and then to treat the waste stream using ultra-filtration. The pH adjustment and treatment would change the pH of the effluent and would reduce the mercury, other metals, and other parameters of concern that are present in the leachate. Recent analysis also indicates that the concentrations of mercury and other parameters of concern (chlorides, total dissolved solids, etc.) in the collected leachate have decreased over time. The proposed discharge would meet state water quality standards and a variance granted under Rule 323.1103 for mercury as well as several other constituents identified in the attached variance request. The proposed discharge would discharge into the Bay in the

same area that the leachate has discharged prior to the response activities CMS has undertaken at the site.

The Proposed Discharge Is Not To Subject To The Antidegradation Rule Because It Does Not Constitute A New Or Increased Loading Of Pollutants To The Bay

The Antidegradation Rule, Rule 323.1098, applies only to an "action or activity pursuant to Part 31" of the Michigan Natural Resources and Environmental Protection Act (NREPA), MCL 324.3101 *et seq.*, "that is anticipated to result in a new or increased loading of pollutants." Rule 323.1098(1). However, the proposed discharge does not constitute a new or increased loading of pollutants to the Bay.

The proposed discharge consists of groundwater impacted by CKD and intercepted before it enters the Bay. This groundwater, i.e., the "intake water," is the same water body as the Bay and contains parameters and pollutants of concern that have been documented to have been discharging from the site into the Bay for many years. Given the long history of this discharge from the site to the receiving water designated in this application, this discharge cannot be said to be a "new" loading of pollutants to the Bay within the meaning of Rule 323.1098(1).

Additionally, the discharge is proposed to decrease or maintain the loadings of the parameters and pollutants that have historically discharged from the site to the Bay. For instance, the groundwater that is collected has a hydrogen ion concentration (pH) that exceeds 9.0 s.u. The treatment proposed for this discharge would lower that pH below 9.0 s.u. and fall within the water quality standard established in Rule 323.1053. Similarly, the groundwater that it collected has a mercury concentration that is typically in a range of 20 ppt to 500 ppt depending on the collection location. The treatment would lower the mercury concentration to 10 ppt to or less and would be consistent with a variance issued for this discharge. The other response activities at the Development Area are also aimed at and believed to be reducing the pollutants and parameters of interest in the impacted groundwater that is collected. CMS is not proposing to increase the loading of any pollutants to the Bay with this discharge, even if a variance for mercury is granted.

The proposed discharge does not meet either of the two threshold requirements for the application of the Antidegradation Rule because it is not an action or activity under Part 31 that is anticipated to result in a new or increased loading of pollutants to the Bay. Accordingly, the Antidegradation Rule does not apply to this proposed discharge.

The Proposed Discharge Is Exempt From The Antidegradation Rule

Even if this proposed discharge were to result in a new or increased loading of pollutants to the Bay, the Antidegradation Rule exempts a person seeking a control document like an NPDES permit from making an antidegradation demonstration if the person "show[s] how the discharge is exempted under subrule (8) or (9) of this rule" Rule 323.1098(4). In this case, the proposed discharge is exempted under subrule (8).

Rule 323.1098(8) states in relevant part that, “[e]xcept for water bodies designated as OSRWs, or as the department may determine on a case-by-case basis that the application of the procedures in this rule are required to adequately protect water quality, the following do not constitute a lowering of water quality” The circumstances that qualify for an exemption identified in subrule (8) include “[r]esponse actions undertaken to alleviate a release into the environment of pollutants that may pose an imminent and substantial danger to the public health or welfare under” CERCLA and other enumerated environmental statutes, including Part 201 of NREPA. Rule 323.1098(8)(c)(i) and (iii). This proposed discharge qualifies for the exemption in Rule 323.1098(c)(i) because it is one of the response actions CMS has undertaken at Bay Harbor to alleviate a release into the environment of pollutants that have been deemed an imminent and substantial danger to the public health and welfare by the United States Environmental Protection Agency. The imminent and substantial danger posed by the leachate if released into the environment is demonstrated in the AOC, EPA orders and correspondence, local health advisories (all of which have been made separately available to MDEQ), as well as other materials.

Further, neither of the two exceptions in Rule 323.1098(8) are relevant to this proposed discharge. The Bay has not been designated an outstanding state resource water in Rule 323.1098(6). Nor is there a factual basis to conclude that the application of the procedures in the Antidegradation Rule are necessary to adequately protect water quality because this discharge eligible for a mercury variance, will meet all other state water quality standards, and will comply with all permit and variance requirements. Therefore, this discharge would be exempt from the requirements of the Antidegradation Rule even if it constituted a new or increased loading of pollutants to the Bay.

Alternatives Analysis

MDEQ has requested that CMS present an analysis of the feasible and prudent disposal alternatives to this proposed surface water discharge as part of this Antidegradation statement. CMS respectfully maintains that such an analysis is not legally required, particularly when the discharge has been proposed as a response activity under CERCLA. Nevertheless, it presents this description of the alternatives to a surface water discharge it has considered that fit within the categories identified in Water Bureau’s Procedure No. 14.

Groundwater discharge – On-site groundwater discharge is likely to be incompatible with the goals of the response activities because of the potential to generate more leachate. This is not a prudent and feasible alternative to the proposed discharge.

Land application by sprayfield is the most likely method for groundwater discharge off-site. However, this method of discharge is expected to result in minimal removal of contaminants of interest because of the mineral characteristics of the leachate, resulting in dilution of contaminants of concern in the groundwater. The local use of groundwater as a drinking water source is expected to result in public objections to this option. There are also other restraints on this alternative, including the large number of acres of land and

large size of a spray system to handle the volume of water collected at the Development Area Park; the need for the sprayfield operation to be within piping distance of Bay Harbor; limits on the number of inches of water that can be applied to fields each year; the need for millions of gallons of storage capacity for when precipitation and seasonal conditions prevent land application; and the need to rotate land to prevent the buildup of salts from the leachate. This is not a prudent and feasible alternative to the proposed discharge.

Discharge to available sewerage systems – The City of Petoskey maintains a sewer along US-31 near the Bay Harbor site that connects to its wastewater treatment plant. CMS is willing to connect to this sewer and discharge its leachate to the City's wastewater treatment plant, but the City has not indicated its willingness to allow CMS to pursue this alternative. Therefore, this discharge is not "available" to CMS and is not a prudent and feasible alternative to the proposed discharge.

CMS has been in talks with the City of Petoskey to discharge its leachate to the City's wastewater treatment plant through a dedicated sewer line running several miles. These talks have been proceeding in good faith for months and the parties have yet to reach agreement regarding the reasonable technical requirements for this option. The City's December 14, 2009 correspondence with MDEQ concerning these technical requirements indicates that the requirements are not routinely imposed on industrial dischargers subject to the City's industrial pretreatment ordinance. Further, in that letter the City does not commit to allowing CMS to discharge if its requirements are met, but states that it is subject to additional approvals from and additional conditions imposed by the City Council.

Even assuming it is possible to reach agreement on all technical and additional requirements imposed by the City of Petoskey, the time it will take to come to agreement and construct the infrastructure the City will require makes this option not "available" to CMS. The millions of dollars it will cost to construct this infrastructure is also unwarranted for numerous reasons, including: the US-31 sewer makes much of this cost unnecessary; there is no net environmental benefit from this option because the City discharges to the same receiving water proposed in this permit application, but without the treatment technology CMS is proposing to implement; and because when all requirements and conditions are met and millions of dollars spent, the City's position is that the pending litigation may still bar this option. Therefore, this is not a prudent and feasible alternative to the proposed discharge.

Water reuse – CMS does not operate an industrial facility at the Development Area and has no process in which to reuse the groundwater it collects at the site. On-site reuse of the water as irrigation water is also disfavored because it may produce more leachate, contrary to the goals of the response activities, is not an option during many months of the year, and there may be inadequate surface area to handle the volume of water (see sprayfield discussion, above). This is not a prudent and feasible alternative to the proposed discharge.

Water recycling – CMS does not operate an industrial facility at the Development Area and has no process in which or method to recycle the groundwater it collects. This is not a prudent and feasible alternative to the proposed discharge.

Pollution prevention alternatives – CMS has implemented a series of pollution prevention alternatives, including removing portions of the CKD, and covering and contouring the remaining CKD. However, those pollution prevention alternatives do not eliminate the need to collect and dispose of leachate. Additionally, CMS does not know of other cost-effective pollution prevention alternatives and techniques which have been adequately demonstrated and which are reasonably available that would eliminate or significantly reduce the discharge of mercury below the levels proposed in this permit application. To the contrary, collecting, treating, and discharging / disposing of CKD-impacted groundwater is a pollution prevention method required by the AOC with the EPA and cannot be eliminated from the cleanup at this time. This is not a prudent and feasible alternative to the proposed discharge.

Alternative or enhanced treatment techniques – CMS is seeking a variance from the water quality standard for mercury that cannot be removed from this waste stream with the treatment technology it is proposing to implement. This mercury does not “result from operations at a facility” within the meaning of Rule 323.1098(4)(b). Nevertheless, CMS is proposing to implement the best adequately demonstrated and commercially available treatment technology for the mercury in this waste stream. CMS does not know of alternative or enhanced treatment techniques which have been adequately demonstrated, are reasonably available, have a cost that is reasonable relative to the cost of treatment, and would eliminate the discharge of mercury or lower the discharge to 1.3 ppt, nor reduce or eliminate the discharge of other constituents addressed in the variance request.

With respect to all other contaminants or parameters of interest, CMS is proposing to meet all relevant surface water standards, making alternative or enhanced treatment techniques unnecessary. This is not a prudent and feasible alternative to the proposed discharge.

Other Options – CMS has considered or pursued other disposal options, none of which constitute a prudent and feasible alternative for the long-term disposal of leachate collected at Bay Harbor. Those options are also outside the scope of Water Bureau's consideration in this permit application. They include, but are not limited to the following:

CMS currently trucks a portion of the leachate to a commercially operated, off-site injection well for disposal. This is not a long-term option for the disposal of leachate because CMS does not have adequate control over the available capacity and outages. This is also a very expensive option (\$0.10 per gallon) in comparison to the proposed surface water discharge at the Development Area (\$0.04 per gallon). The need to truck the leachate, whether for this or any other option, not only substantially adds to the per-gallon cost of leachate disposal, but creates environmental tradeoffs from fuel use and

emissions. Trucking is an inconsistent option for this large volume of leachate because it can be disrupted by inclement weather, road construction, and other factors. Local communities also object to the increased truck traffic and the risk of accidents from trucking.

CMS currently trucks a portion of the leachate to a publicly owned wastewater treatment plant in another community for treatment and discharge to Lake Michigan. This is not a long-term option for the disposal of leachate because CMS does not have adequate control over the available capacity and constituent limits. This is also a very expensive option (\$0.10 per gallon) in comparison to the proposed surface water discharge at the Development Area (\$0.04 per gallon). The need to truck the leachate also includes the tradeoffs discussed above.

Beeland Group, LLC obtained federal and state permits for an injection well for Bay Harbor leachate in Alba, Michigan, closer to Bay Harbor than the current commercial injection well that takes a portion of the leachate from the Development Area. However, Beeland Group was sued by local opponents and is subject to an injunction that prevents the construction, testing, and operation of the injection well at this time.

CMS has applied for federal and state permits for an injection well in Emmet County at MDEQ's request. Limited data concerning local geology makes it uncertain whether the permits will be granted and whether an Emmet County injection well could take all the leachate for disposal. If the permits are granted, there are likely to be challenges to the permits or the permittee that prevent such a well from being used in the foreseeable future, as happened with the Beeland well.

CMS evaluated the use of evaporation ponds. However, numerous ponds would need to be constructed within a close distance to Bay Harbor to allow the leachate to be piped to the location. The evaporation would have to be energy-assisted because of moisture saturation of the air near Lake Michigan. The construction and energy costs make this option cost-prohibitive.

Bay Harbor Resort – Development Area
NPDES Permit Application
Request for a Variance

Summary of Facts

The background facts surrounding the Bay Harbor site are summarized in the statement CMS has prepared concerning the applicability of the antidegradation rule, Rule 323.1098, which is being submitted to MDEQ with this variance request. That summary is incorporated here by reference.

Request for a Variance Under Rule 323.1103

CMS requests that it be granted a variance from the 1.3 ng/L water quality standard established for mercury under Rule 323.1057. CMS requests that its application for an NPDES permit be granted and that the permit be issued with a water quality based effluent limit of 10 ng/L for mercury for the term of the NPDES permit and that it stay in effect until the permit is reissued. CMS also requests that the variance apply to the parameters listed in the table on page 6 at the levels stated for this period. As CMS explains below, granting an NPDES permit with a variance for this proposed discharge is a critical element of the response activities that it is implementing at Bay Harbor in this cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601 *et seq.*, and is allowable under the variance rule, Rule 323.1103.

The Proposed Discharge Is Eligible For A Variance – Rule 323.1103(1)(b)

The proposed discharge of treated leachate from the Development Area at the Bay Harbor site is eligible for a variance under Rule 323.1103 as an existing discharge. There is historical evidence of leachate discharging from the Development Area of Bay Harbor to the Little Traverse Bay (Bay) prior to July 29, 1997.

Even if the proposed discharge is a new discharge, it is eligible for a variance under Rule 323.1103(1)(b) because the “proposed discharge is necessary to alleviate an imminent and substantial danger to the public health or welfare.” The collection, treatment, and disposal of leachate from the Bay Harbor Development Area are response activities undertaken by CMS pursuant to the removal action and other provisions of CERCLA and the administrative order on consent into which CMS and the United States Environmental Protection Agency (EPA) entered. These response activities are intended to alleviate the imminent and substantial danger to the public health or welfare posed by cement kiln dust (CKD) leachate if it migrates to the Bay and shore. This danger is documented in agency materials, as well as materials prepared by CMS that have already been made available to MDEQ as part of the CERCLA action.

The Proposed Discharge Does Not Jeopardize Endangered or Threatened Species – Rule 323.1103(1)(c)

The variance requested would not be likely to jeopardize the continued existence of any endangered or threatened species listed under section 4 of the endangered species act or result in the destruction or adverse modification of the species' critical habitat. A mercury variance of 10 ng/L is within the range of levels currently achievable used to calculate mercury variances for existing discharges under MDEQ's EPA-approved multiple discharger variance. Further, a discharge of 10 ng/L of mercury and the discharge of other parameters at the concentrations listed in the table on page 6 represents a decrease in the discharge of these substances from the Development Area, which is intended to be protective of wildlife.

The Proposed Discharge Meets Applicable Technology Requirements and CMS Has Implemented Controls Over Nonpoint Sources – Rule 323.1103(1)(d)

MDEQ is not prohibited from granting a variance to CMS because it is proposing to implement the best commercially available treatment technology for the leachate it collects, meeting applicable treatment technology requirements under the Clean Water Act. This technology is unable to reduce mercury in the leachate that CMS collects to meet 1.3 ng/L, nor to reduce the other parameters proposed for the variance.

CMS has also implemented cost-effective and reasonable best management practices for nonpoint sources over which it has control in the vicinity of the Bay Harbor Development Area in the context of the CERCLA cleanup. These efforts include but are not limited to removing, covering, and contouring CKD to decrease water infiltration into CKD piles and leachate production. These efforts and natural changes in the impacts of CKD over time are believed to have decreased the concentrations of pollutants and parameters of concern in the leachate that CMS collects, but they are not able to reduce those concentrations in leachate to the water quality standards. CMS's ability to impose additional controls on nonpoint sources of those parameters in the vicinity of the Bay Harbor Development Area is limited by a number of factors, including its limited ownership and control in that area.

CMS is Seeking a Variance for an Allowable Period – Rule 323.1103(1)(e)

CMS is asking that a variance be granted for the term of the NPDES permit issued to it for this proposed discharge and that the variance stay in effect until the permit is reissued. This requested effective period for the variance is allowable under Rule 323.1103(1)(e).

The Proposed Discharge Is Eligible for a Variance Because Attaining the Water Quality Standard Is Not Feasible for One or More Specified Reasons – Rule 323.1103(2)

Attaining the water quality standard for mercury and the other parameters identified in the table on page 6 is not feasible for one or more of the reasons specified in Rule

323.1103(2) and is supported by the materials made available to MDEQ as part of the CERCLA cleanup.

Rule 323.1103(2)(b) allows a variance upon a showing that "[n]atural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the WQS." The collection lines are designed and constructed to maximize the interception of high pH leachate that poses a threat to the public health or welfare. By targeting concentrated leachate, Bay Harbor operates in a low flow condition without the benefit of additional dilution by groundwater.

Rule 323.1103(2)(c) allows a variance if "[h]uman-caused conditions or sources of pollution prevent the attainment of the WQS and cannot be remedied or more environmental damage would occur in correcting the conditions or sources of pollution than would occur by leaving the conditions or sources in place." Response activities by their very nature seek to "remedy" "human-caused conditions" or "pollution." More than one hundred years of cement production and CKD disposal practices by other, unrelated parties (human-caused conditions) at the Development Area of Bay Harbor led to the production and venting of leachate to the Bay and the nonattainment of water quality standards for a variety of water quality parameters (pollution). EPA has determined that leaving the high pH leachate in place to vent to the Bay and cause direct contact threats would cause more environmental damage than collecting, treating, and disposing of the leachate, which is what CMS is proposing to do with this discharge. Leaving the CKD leachate in place to vent to the Bay would pose more of a threat to the environment than requiring its collection and allowing its treatment and discharge.

Rule 323.1103(2)(d) allows a variance if "[d]ams, diversions, or other types of hydrologic modifications preclude the attainment of the WQS, and it is not feasible to restore the water body to its original condition or to operate the modification in a way that would result in the attainment of the WQS." The cleanup at the Development Area at Bay Harbor includes extensive hydrologic modifications to groundwater, including: collection lines that intercept leachate before it vents to Lake Michigan; the influence of area groundwater wells; and cover and surface feature contours that are designed to prevent surface water from infiltrating the CKD and reaching the groundwater. These hydrologic modifications are intended to and do result in the collection of concentrated leachate that cannot meet water quality standards. To operate these hydrological modifications differently would result in CMS's failure to collect this concentrated leachate before it vents to the Bay, contrary to the goals of its response actions, and these modification cannot be operated in a way that would attain the water quality standard for mercury.

Rule 323.1103(2)(e) allows a variance if "[p]hysical conditions related to the natural features of the water body preclude attainment of WQS." The regional groundwater flow that moves through Bay Harbor on its way to the Bay is a physical condition that prevents the attainment of water quality standards because it creates leachate when it comes in contact with CKD. Additionally, the features of native bedrock in relation to groundwater affects where leachate is created and vented, affecting the location and

nature of response activities that collect concentrated leachate that cannot meet water quality standards.

Rule 323.1103(2)(f) allows a variance if more stringent technology controls “would result in unreasonable economic effects on the discharger and affected communities.” The unreasonable economic effects of implementing more stringent controls for mercury is documented in MDEQ’s submittal to EPA in connection with its multiple discharger variance for mercury. More stringent controls for the other parameters proposed for a variance would likely be similarly expensive. CMS is already implementing the best commercially available treatment technology and would incur unreasonable expense in attempting to develop, gain approval for, and implement novel technology, which would divert economic resources from other response activities. Local communities are depending on CMS to cleanup Bay Harbor and improve conditions of the Bay, both of which are critical attractions that contribute to the local economy.

The Requested Variance Meets the Antidegradation Requirements – Rule 323.1103(3)(a)

CMS has submitted a separate antidegradation statement to MDEQ and has established that its discharge even with a variance conforms to Rule 323.1098 because it does not propose a new or increased loading of the pollutants to the Bay and, in any case, would be exempt under subsection (8)(c)(i). That statement is incorporated here by reference.

The Requested Variance Does Not Increase Risk to Human Health and the Environment – Rule 323.1103(3)(b)

CMS does not have treatment technology commercially available to it that would attain the water quality standard for mercury. The variance would not, however, represent an increased risk to human health and the variance because CMS is seeking to treat the leachate to reduce the loading of mercury to the Bay over its historical levels. Granting the variance is consistent with the protection of the public health, safety, and welfare because it is part of and facilitates the response activities at Bay Harbor.

CMS Is Not Obligated To Address Alternatives In This Request, But Has No Prudent And Feasible Alternatives To This Discharge With A Variance

Rule 323.1103 does not require CMS to submit an alternatives analysis. However, CMS has submitted an alternatives analysis in its separate antidegradation statement, which is incorporated here by reference. That alternatives analysis explains that CMS does not have a prudent and feasible alternative to the collection, treatment, and discharge of this CKD leachate pursuant to an NPDES permit with a mercury variance.

Proposed Treatment System Pilot Results Supports Variance

The proposed treatment system at the Development is based on the results of two (2) pilot scale studies. Three primary methods of treatment were explored including:

- pH adjustment with chemical coagulation and conventional filtration
- pH adjustment with conventional coagulation-flocculation-sedimentation
- pH adjustment with chemical coagulation and ultra-filtration (UF)

Conventional filtration following pH adjustment would reduce mercury concentrations from an influent leachate level of 500 ng/L to approximately 110 ng/l. The conventional coagulation-flocculation-sedimentation process following pH adjustment was able to reduce mercury to an average concentration of 83 ng/l. The initial pilot using pH adjustment followed by chemical coagulation with alum and metal precipitant and UF filtration reduced the effluent mercury concentration to a range of 20 to 30 ng/l from the influent level of 500 ng/l. The currently on-going pilot using pH adjustment, coagulation/flocculation and UF filtration reduced the effluent mercury from an influent concentration of 50 ng/L (blend of all four (4) influents) to a range of 1.8 – 4.7 ng/L.

Although significant removal of mercury and other pollutants of concern from influent will occur through the application of this “Best Professional Judgment” (BPJ) treatment technology resulting in reduction in the mercury loading to Little Traverse Bay from the Development seepage sites, it is expected that the resultant mercury concentration in the effluent will be above the water quality standard of 1.3 ng/L. As a result, CMS is requesting a variance in accordance with the terms and conditions of the Part 4 Rules (R 323.1103(1)(b), which is consistent with MDEQ’S Mercury Permitting Strategy. Similarly, other pollutants of concern are projected to be above water quality standards (see table below) and CMS is requesting a variance for these pollutants as well.

Elimination of the source of mercury and other pollutants is not feasible due to the extent and location of the CKD deposited historically in the resort area. CMS has removed, contoured, and covered portions of the CKD in the Development areas and is intercepting and disposing of leachate off-site. Although this action has reduced the loadings to the Bay it has not completely eliminated the input.

Collection and treatment of the groundwater seepage utilizing the proposed BPJ treatment technology will eliminate this threat to public health or welfare by adjustment of the pH and elimination of a significant mercury load to Little Traverse Bay.

A full-size permanent system to be operationally effective will need to be operated at either batch or continuous mode at 40/50X or greater and cleaned only periodically, reducing operating issues and waste disposal volumes (UF concentrate and system cleaning wastes). The Parsons Group Pilot Study (see Appendix B) and the experience of the Koch Membrane System found that metals removal decreases somewhat when the UF system is run continuously at higher concentration factors (>10X). It is projected that under full-scale, continuous operation, removal rates will be greater than 90%.

The following table gives the concentrations of the parameters of concern being requested:

Parameter	Water Quality Standard	Current Pilot Effluent Concentration	Requested Concentration Limitation
Total Dissolved Solids (TDS)	750 mg/L	4,000 – 7,000 mg/L	8,000 mg/L
Vanadium (V)	12 ug/L	20 – 40 ug/L	60 ug/L
Chloride (CL)	50 mg/L	300 mg/L	500 mg/L
Mercury (Hg)	1.3 ng/L	1.8 – 4.7 ng/L	10 ng/L
Copper (Cu)	11 ug/L	14 ug/L	30 ng/L
Selenium (Se)	5 ug/L	15-20 ug/L	35 ug/L

CMS anticipates developing Pollutant Minimization Plans for mercury and other pollutants of concern as appropriate, and is prepared to design and orient an outfall structure that will allow for dilution or use modeling to show compliance with limits. The optimum design, location, configuration, and orientation of the discharge structure(s) will be determined through in-lake biological surveys and modeling. The results of the surveys and modeling, and the outfall design and the details of construction will be shared with the Department, the Army Corps of Engineers, and other agencies and stakeholders for review, comment, and concurrence. Through modeling or by providing an appropriately sized and oriented outfall structure the toxicity of the effluent due to the high concentration of total dissolved solids will meet water quality standards at the edge of any mixing zone that may be established. CMS anticipates providing a demonstration (Rule 323.1082) using the Department's Procedure 51 that the discharge has no impact on the biota in the area of the discharge.

In addition to the parameters of concern, CMS anticipates discharge limitations for pH (6.5 – 9.0 s.u.), dissolved oxygen (7.0 mg/L), and total suspended solids (20 mg/L).

CMS Bay Harbor Development
NPDES Permit Application
Section I – Part 10 – Water Flow Diagram and Narrative Description

Narrative Description of Pilot Treatment System and Layout:

The objectives of the current Pilot Treatment study are the following:

1. Gather operational data to confirm optimum design parameters.
2. Evaluate pollutant reduction during the pilot tests.
3. Compare UF permeate quality to regulatory requirements for discharge to Lake Michigan.
4. Analyze samples from the pilot, including influent(s), pH-adjusted, coagulated/flocculated, and UF concentrate (return), permeate (effluent) from different concentrate levels as well as filter cleaning water to document pollutant removal and system mass balance.

The Pilot pre-treatment system basically consists of five (5) processes:

1. Influent collection.
2. Influent metering/mixing.
3. pH adjustment using sulfuric acid (98%).
4. Coagulation/flocculation (alum and metal precipitant).
5. Ultrafiltration (UF).

Each of the five (5) processes is described below and schematics of process flow and system layout are provided in *Pilot Treatment System*, Figure 1 and *Pilot Treatment System Floorplan*, Figure 2, Appendix C:

Influent Collection

- Each of the four (4) separate influent lines is tapped just before entering the CMS Pretreatment Facility. The influent lines consist of:
 - Seep 1
 - Seep 2W (Seep 2 + West CKD)
 - Edge Drain
 - TLC (Targeted Leachate Collection)

The pilot treatment system water balance is as follows. This table has been created using 2009 raw flow data provided by CMS:

Influent	Daily Avg. Flow Rate (GPM)	Percent (%) of Total Daily Flow	Flow ¹ (GPM)	Flow ¹ (GPH)	Flow ¹ (mL/MIN)	pH	ng/L Hg
Seep 1	38.29	39.0%	2.7	163.9	10,339.0	12.5	50
Seep 2W (Seep 2 + WCKD)	51.00	52.0%	3.6	218.3	13,771.7	12.0	20
Edge Drain	8.09	8.2%	0.6	34.6	2,184.7	12.5	80
TLC	0.75	0.8%	0.1	3.2	202.5	13.2	500
Total	98.13	100%	7.0	420.0	26,497.9	-	-

¹ FLOW COMPOSITION IS BASED ON 7 GPM COMBINED INFLUENT FLOW.

- Four (4), 55-gallon plastic head tanks, one for each of the valved influent streams (each tank is equipped with an over-fill line and mixing pump).

Influent Metering/Mixing

- Each 55-gallon head tank is equipped with a 'downstream' pump, flow meter, and sample port.
- All four (4) influent streams are individually pumped through the flow meters and sample ports into a valved manifold.
- The influent streams are metered (Daily Average Flow Rate) into the 300-gallon poly (plastic) pH adjustment tank.

pH Adjustment

- In the pH adjustment tank, the combined influent is treated with Sulfuric Acid (98% H₂SO₄) to a pH of 8.0 to 8.5.
- The Combined Influent is then pumped (@ 3.5 gpm) through a flow meter and sample port before entering a 55-gallon chemical addition tank.

Coagulation/Flocculation

- Aluminum sulfate (alum; Aquamark 120) is added at a dosing rate of 20 to 50 mg/L and mixed with a ¼ hP mixer. This tank has a 15-minute retention time.
- The alum-treated influent is then treated in another 55-gallon mix reactor with a metal precipitant (Aquamark 131), again at a dosing rate of 20 to 50 mg/L and mixed with a ¼ hP mixer (15-minute retention time).
- After pH adjustment and coagulation/flocculation the influent is then pumped (@ 3.5 gpm) through a flow meter and sample port before entering the Ultrafiltration (UF) Skid (Pilot Unit) - (provided by Koch Membrane Systems).

Ultrafiltration

- The UF Pilot Skid contains the following elements (Refer to Appendix D):
 - One (1) 320 gallon, multi-compartment tank with Process, Cleaning and Permeate sections. Process section has level controls.
 - One (1) process circulation pump with a 10 HP, 130/460 VAC, 60 cycle, 3500 RPM motor.
 - One (1) inlet Y-strainer.
 - Two (2) pressure gauges.
 - One (1) inlet low pressure switch.
 - One (1) temperature gauge.
 - One (1) inlet high temperature switch.
 - Sixteen (16) 1" diameter x 10' long, tubular CPVC, UF membranes.
 - Eight (8) membranes with molecular weight cut-off of 100,000 Dalton (10-HFM-251-PVI).
 - Eight (8) membranes with molecular weight cut-off of 120,000 Dalton (10-HFP-276-PVI).
 - Unit piping and manual valves.
 - One (1) control panel with motor starter, operator switches and local alarms.
- "Downstream" of the Ultrafiltration Skid are two (2) >600-gallon poly tanks to collect the permeate (final effluent), concentrate (sludge) and filter cleaning waste from the UF Skid. These tanks also collect any overflows/bypasses from the system. From the poly tank the waste is pumped to the on-site frac tanks. In a full-scale system, the effluent would be pumped to a discharge pipe, and the concentrate, cleaning wastes, and any overflows would be trucked to off-site disposal.

The Pilot Treatment System has been constructed in a portable trailer. A layout of the system is included in Figure 2, *Pilot Treatment System Floor Plan* in Appendix C.

Description of Chemical Feeds:

Alum Addition (Aquamark 120, see Appendix F):

Alum is added at a rate of 20 mg/L to 50 mg/L. The feed rate is recorded for each "run" of the system.

When suspended in water, particles finer than 0.1 μm remain suspended due to electrostatic charge (usually negative) which causes them to repel each other. This charge can be neutralized by the use of coagulant chemical, causing the particles to agglomerate under the influence of Van der Waals's forces. These larger and heavier particles are called flocs and the coagulant chemical is a flocculant or flocculating agent. Typically flocculants are multivalent cations such as aluminum, iron, calcium or magnesium. In the treatment process described here the flocculant is alum [aluminum sulfate, $\text{Al}_2(\text{SO}_4)_3$]. These multivalent cations interact with negatively

charged particles and molecules to promote aggregation. Also, alum will react with dissolved species in water to form insoluble hydroxides which, upon precipitating, link together to form long chains or meshes, physically trapping small particles into the larger flocs.

Metal Precipitant Addition (Aquamark 131, see Appendix F):

Metal precipitant is added at a rate of 20 mg/L to 50 mg/L. The feed rate is recorded for each "run" of the system.

The metal precipitation step in the treatment process is accomplished using AQ 131 (Aquamark, Inc.). This is a compound in the generic category *hydropolysulfide*, specifically carbonothioylbis-, disodium salt (CAS# 128578-22-3). Hydropolysulfides such as AQ 131 react with dissolved metals and metal compounds to form metallic thiocarbonates or sulfides. These stable compounds are not toxic or hazardous and, in fact, are similar to their common metallic forms in nature, which maintain and increase their stability over time.

Ultrafiltration Unit (Refer to Koch Membrane Systems information in Appendix D):

- Cross-flow membrane filtration is a pressure-driven process.
- The membranes serve as a physical barrier that permits the passage of materials only up to a certain size, shape or character.

Ultrafiltration (UF) is a low pressure (20 – 100 psig; pilot runs at 56 psig) process intended to remove high molecular weight components in addition to suspended solids. Low molecular weight components pass freely through UF membranes. Ultrafiltration is typically defined to be in the 10 to 200 Å range. The pilot uses two (2) types of ultrafiltration membranes:

- Eight (8) membranes with molecular weight cut-off of 100,000 Dalton (10-HFM-251-PVI).
- Eight (8) membranes with molecular weight cut-off of 120,000 Dalton (10-HFP-276-PVI).

Results of Currently On-going Pilot Study:

Three (3) test runs of the Pilot Treatment System were run during the weeks of November 2nd and November 9th, 2009. Each test run of the UF lasted about ten (10) hours. The UF was thoroughly cleaned between each run. The testing was done on flow-weighted mixtures of all four (4) of the individual influent streams. In all of three (3) runs, treatment achieved over 90% removal of the mercury and other heavy metals, and total suspended solids. The treatment did not reduce levels of total dissolved solids, however. Complete laboratory test results for these three (3) tests are included in Appendix E.

The first of these test runs used an addition of 20 mg/L each of Alum (Aquamark 120) and metal precipitant (Aquamark 131). The retention time in the chemical reaction tanks for this test run was fifteen (15) minutes. The test was run to 17X (a ratio of 17 parts permeate (effluent) to 1 part concentrate (sludge)).

The second and third of these test runs used an addition of 50 mg/l each of Alum (Aquamark 120) and metal precipitant (Aquamark 131). The retention time for tests No. 2 and 3 was twenty (20) minutes. Test 2 was run to 30X while Test 3 was run to 20X.

The data indicates that there are no losses of water in the system and that there is no loss of pollutants prior to ultrafiltration. During cleaning of the head tanks, chemical feed tanks, and UF no accumulation of solids was noted.

The testing continues with runs of various combinations of influent, each individual influent stream, runs using other coagulation/flocculation chemicals and dose rates, runs to various concentration factors (20X – 100X) and runs of increasing lengths (up to 5 days continuous). Preliminary results for the additional one (1) day tests indicate that metals removal is consistent at >90%.

Toxicity testing was conducted on the 10X effluents of Runs 1 and 3. The preliminary results are presented in Appendix E. The effluent was acutely toxic ranging from an LC50 of 8.01 (C. daphnia) to 25 (P. promelas). The toxicity is attributed to the high levels of total dissolved solids (5,000 – 7,000 mg/L) in the effluent. The dissolved solids impair respiration in the test organisms.

Sampling Protocol:

In general, grab samples were collected at specified locations within the treatment process during each run:

1. Each individual influent stream.
2. The combined influent.
3. The pH-adjusted stream.
4. The alum-treated stream.
5. The metal precipitant-treated stream.
6. The Ultrafiltration (UF) permeate at 1X, 5X, 10X and Final X (FX).
7. The UF concentrate at 5X, 10X and FX.

Generally, the Combined Influent (CI) and UF 10X samples were analyzed for a variety of constituents (Appendix E) while the water at other sampling points was tested for a few key constituents including:

- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- Mercury (Hg)
- Vanadium (V)

- Potassium (K)
- Chloride (CL⁻)
- Sulfate (SO₄²⁻)

The sludge (UF Concentrate) typically was analyzed for a total of twelve (12) constituents as well as percent solids and solids by weight (see *Sludge Analytical Form*, Appendix E).

CMS Bay Harbor Development
NPDES Permit Application
Section III – Part B.3 – Parameter Reporting Waiver Request

The outfall information effluent characteristics parameter report for the proposed outfall 001D (Development) was calculated from data collected from the first three (3) runs of the UF Pilot System in November 2009. The full set of analytical results from each run of the treated waste stream has been included in this application (see Appendix E).

There are no analytical results available for total residual chlorine, oil and grease, bacteria, total phosphorus and ammonia nitrogen, but based on the nature of the wastewater and the treatment system there is no reason to believe that there would be levels of concern of these parameters detected in the waste stream or the discharge. CMS Land Company is therefore requesting a waiver from submittal of analytical results for these parameters.

CMS Bay Harbor Development
NPDES Permit Application
Section III – Part 9.C. – Wastewater Treatment Additives
Outfall 001

The following additives will be utilized as part of the pilot wastewater treatment system at the Bay Harbor Development:

- Sulfuric Acid (98%)
 - Alum (Aquamark 120)
 - Metal Precipitant (Aquamark 131) – MDEQ Approved, or
 - Metal Precipitant (Aquamark 155) – MDEQ Approved
1. Material Safety Data Sheets for the water treatment additives are attached in Appendix F.
 2. All additives will react in the treatment process and there will not be a residual discharge concentration of any of the additives
 3. Discharge will occur 365 days per year, however all additives will react in the treatment process and there will not be a residual discharge concentration of any of the additives.
 4. Additives will be utilized in the WWTPs tributary to Outfall 001.
 5. The sulfuric acid will react during pH adjustment and be consumed in the adjustment process. The alum will act as a coagulation agent and combine with the solids in the wastewater solution. The solids removal process will remove the coagulated alum as well. The metal precipitant will react with the metals in the wastewater and be removed by filter and disposed of with concentrate or cleaning water.
 6. Sulfuric acid is used as a pH adjustment additive. Alum and metal precipitant are both coagulation agents.

The following additives will be utilized as part of the filtration system cleaning process at the Bay Harbor Development:

- KOCHKLEEN® 100
- KOCHKLEEN® 222
- KOCHKLEEN® UC III

The cleaning waste will not be discharged to Little Traverse Bay; it will be disposed of by other approved methods.

APPENDIX A



Legend

— Waterways

— Roads

— Municipal Boundary



Aquatic Bed Wetland



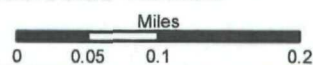
Wooded Wetland



Emergent Wetland



Shrub/Scrub Wetland



CMS Energy
Bay Harbor Resort, Petoskey, MI
Facility Location & Discharge Point
NPDES Permit Application

WCKD

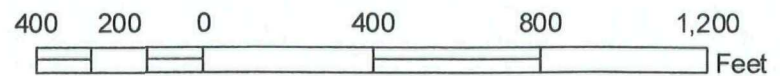
Seep 2

Seep 1

Order Date: 3/26/2007 11:43:24 AM File: C:\Documents and Settings\jim2\Desktop\JM2 Working Folder\Development Collection Drains.mxd User: jim2



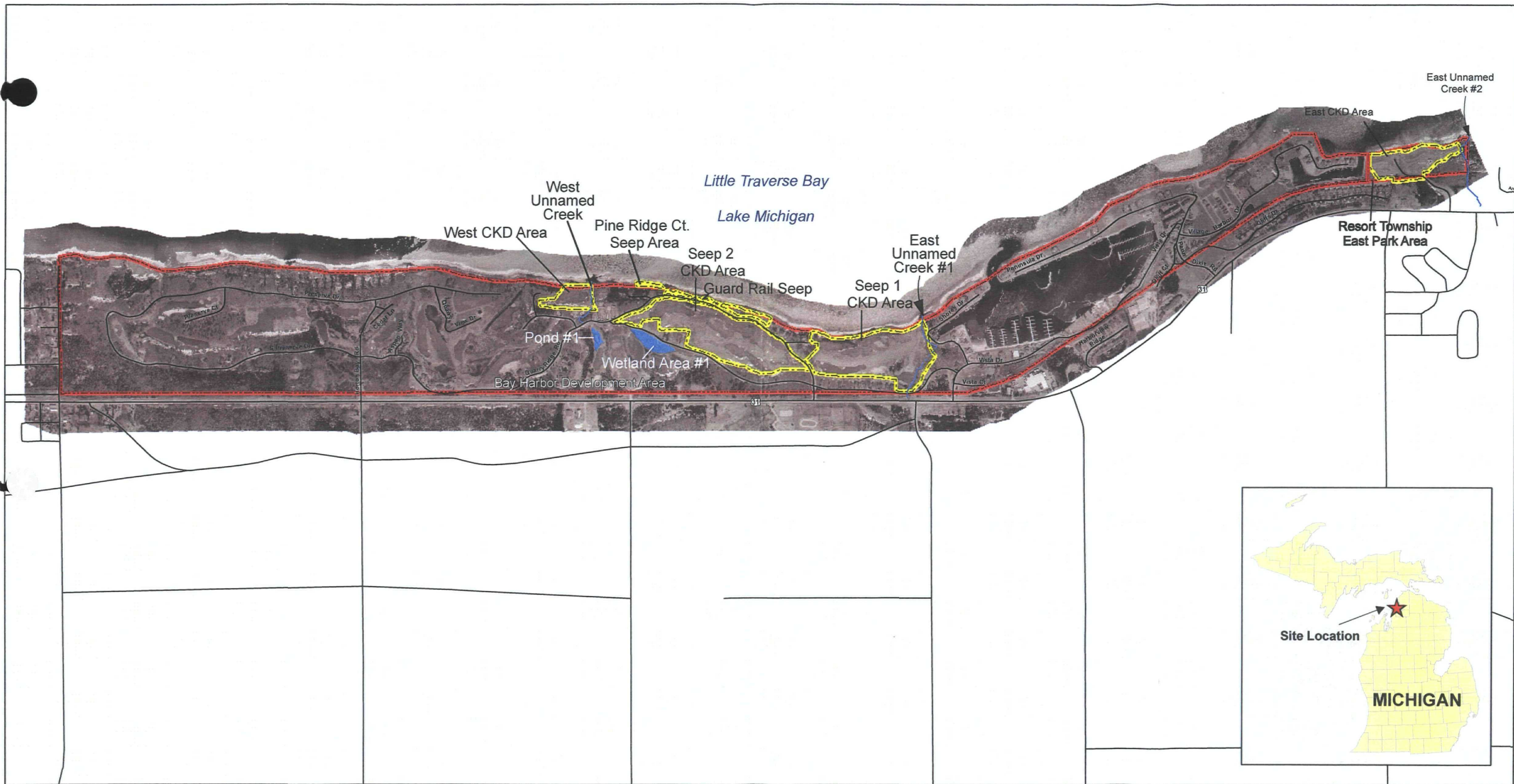
Imagery: April 2005



- Drain Line
- Approximate CKD Extent
- Edge Drain

- Fairway
- Green
- Sand Trap
- Tee Boxes

Development Collection Drains
Little Traverse Bay
CKD Release Site
Emmet County, Michigan



--- CKD Investigation Area
--- Approximate Site Boundary

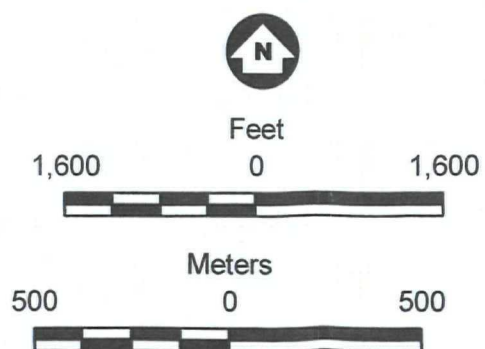
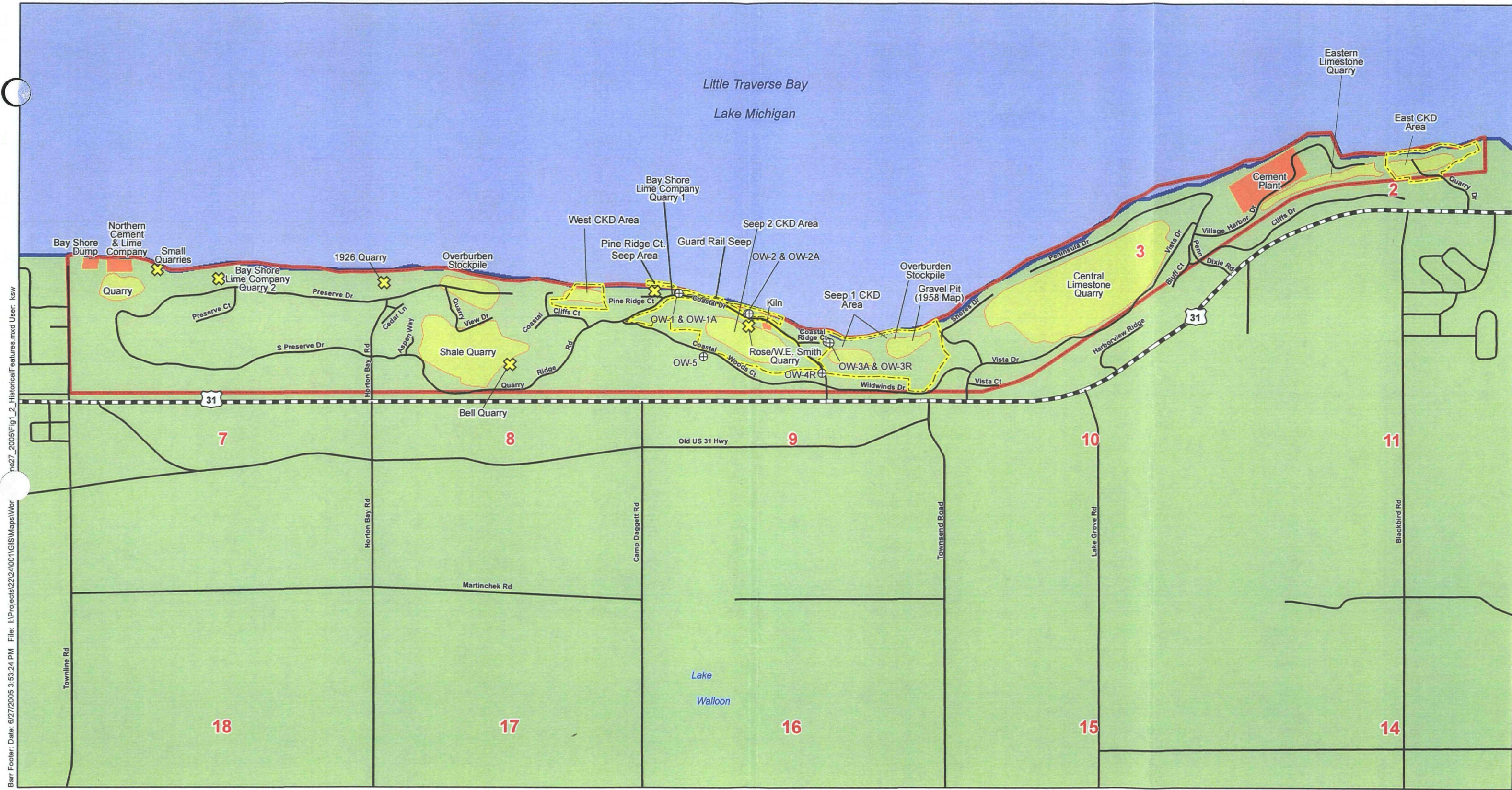


Figure 1-1
 SITE LOCATION
 Little Traverse Bay
 CKD Release Site
 Emmet County, Michigan



Barr Footer: Date: 6/27/2005 3:53:24 PM File: I:\Projects\22424001\GIS\Maps\Wor\ne27_2005\Fig1_2_HistoricalFeatures.mxd User: ksw

- ⊕ Preexisting Monitoring Well
- ✕ General Vicinity of Quarries from the Early 1900s
- General Historical Stockpile and Quarry Extents
- Operational Area
- Current Roadway
- Section Line
- Approximate Site Boundary
- CKD Investigation Areas

Note: Locations of features are approximate.

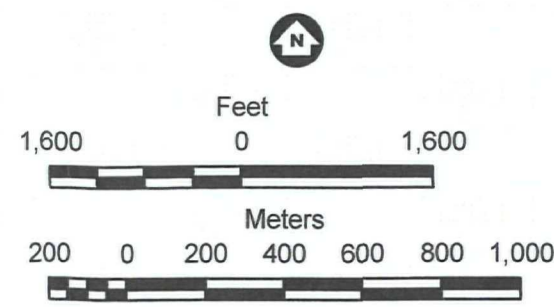


Figure 1-2
HISTORICAL FEATURES
Little Traverse Bay
CKD Release Site
Emmet County, Michigan

APPENDIX B

**PILOT SCALE STUDY REPORT
FOR THE
BAY HARBOR SEEP WATER PRETREATMENT FACILITY
BAY HARBOR RESORT
EMMET COUNTY, PETOSKEY, MICHIGAN**

Prepared for:

**CMS ENERGY
1 ENERGY PLAZA
JACKSON, MICHIGAN 49201**

MAY 2006

Prepared by:

**PARSONS
999 OAKMONT PLAZA DRIVE, SUITE 420
WESTMONT, ILLINOIS 60559**

Parsons Project No. 441409

TABLE OF CONTENTS

SECTION 1.0 INTRODUCTION.....	1
1.1 INTRODUCTION.....	1
SECTION 2.0 BACKGROUND.....	2
2.1 BACKGROUND.....	2
2.1.1 Bench Scale Tests.....	2
2.1.2 Pilot Scale Tests.....	3
2.2 MAJOR PILOT TEST EQUIPMENT.....	8
SECTION 3.0 MEMBRANE ULTRAFILTRATION TESTING.....	11
3.1 BACKGROUND.....	11
3.1.1 Technology Description.....	11
3.1.2 Objectives.....	11
3.1.3 Testing Summary.....	12
3.2 PILOT TEST RESULTS.....	13
3.2.1 Membrane Flux.....	13
3.2.2 Membrane Cleaning and Flux Recovery.....	14
3.2.3 Membrane Permeate Quality.....	16
3.2.4 UF Concentrate.....	20
3.3 SUMMARY.....	21
SECTION 4.0 INCLINED PLATE CLARIFIER TESTING.....	38
4.1 BACKGROUND.....	38
4.2 RESULTS.....	38
4.3 SUMMARY.....	40
SECTION 5.0 CONCLUSIONS.....	41
5.1 CONCLUSIONS.....	41
5.2 PROPOSED TREATMENT SYSTEM DESCRIPTION.....	42
5.2.1 Influent Handling.....	42
5.2.2 pH Adjustment Via Acid Addition.....	42
5.2.3 Coagulation/Precipitation.....	42
5.2.4 Ultrafiltration.....	43
5.2.5 Effluent Handling.....	43
5.2.6 Concentrate Handling.....	43

TABLES

TABLE 2.1	Typical Bay Harbor Seep Water Characteristics and POTW Discharge Permit Limits	4
TABLE 2.2	Key Results from Bay Harbor Seep Water Bench Scale Testing	5
TABLE 2.3	Results from Bay Harbor Seep Water Bench Scale Testing of the Ultrafiltration Process	7
TABLE 3.1	Summary of Membrane Ultrafiltration Tests Bay Harbor Seep Water	13
TABLE 3.2	Characteristics of Untreated Bay Harbor Seep Water	16
TABLE 3.3	Summary of Low Level (Method 1631) Mercury Results From UF Permeate Samples	18
TABLE 3.4	UF Feed and UF Permeate Mercury Results as a Function of Nalmet Dose	19
TABLE 3.5	Michigan 10 TCLP Results for Concentrated Bay Harbor Seep Water	20
TABLE 3.6	Predicted Average Effluent Characteristics for Treatment of Bay Harbor Seep Water Using an UF Membrane Process with Concentration to 10X	22
TABLE 4.1	Results from Clarifier Testing of Bay Harbor Seep Water	39
TABLE 4.2	Michigan 10 TCLP Results for Clarifier Sludge Underflow from Testing of Bay Harbor Seep Water	40

FIGURES

FIGURE 2.1	Bay Harbor Seep Water Pilot System P&ID	10
FIGURE 3.1	UF01-UF03 flux, temperature, and concentration factor results	23
FIGURE 3.2	UF04 flux, temperature, and concentration factor results	23
FIGURE 3.3	UF05 flux, temperature, and concentration factor results	24
FIGURE 3.4	UF06 flux, temperature, and concentration factor results	24
FIGURE 3.5	UF07 flux, temperature, and concentration factor results	25
FIGURE 3.6	UF08 flux, temperature, and concentration factor results	25
FIGURE 3.7	UF09 flux, temperature, and concentration factor results	26
FIGURE 3.8	UF10 flux, temperature, and concentration factor results	26
FIGURE 3.9	UF11 flux, temperature, and concentration factor results	27
FIGURE 3.10	UF12 flux, temperature, and concentration factor results	27

FIGURE 3.11 UF01-UF03 feed and permeate results versus concentration factor	28
FIGURE 3.12 UF04 feed and permeate results versus concentration factor	29
FIGURE 3.13 UF05 feed and permeate results versus concentration factor	30
FIGURE 3.14 UF06 feed and permeate results versus concentration factor	31
FIGURE 3.15 UF07 feed and permeate results versus concentration factor	32
FIGURE 3.16 UF08 feed and permeate results versus concentration factor	33
FIGURE 3.17 UF09 feed and permeate results versus concentration factor	34
FIGURE 3.18 UF10 feed and permeate results versus concentration factor	35
FIGURE 3.19 UF11 feed and permeate results versus concentration factor	36
FIGURE 3.20 UF12 feed and permeate results versus concentration factor	37
FIGURE 5.1 Proposed Bay Harbor Seep Water Treatment System Flow Diagram	44

APPENDICES

APPENDIX A	Pilot Test System Data Logs
APPENDIX B	Pilot Test Summary of Analytical Results

SECTION 1.0 INTRODUCTION

1.1 INTRODUCTION

This Pilot Scale Study Report was prepared on behalf of CMS Energy (CMS) by Parsons and presents a general discussion of the pilot scale treatability studies carried out using Bay Harbor cement kiln dust (CKD) seep water. The seep water emanates from CKD stock piles located on the Bay Harbor property. As part of the site's Michigan Department of Environmental Quality (MDEQ) mandated closure activities, the CKD deposits were contoured and covered with overburden to establish turf for use as a golf course.

A portion of the seep water is collected by a subsurface drainage system installed in the Fall of 1995 by the Bay Harbor Development Company and is pumped to the Bay Harbor Pretreatment Facility operated by CMS. The collected seep water is highly caustic ($\text{pH} > 12$) due to infiltration of surface precipitation and groundwater flow through the cement kiln dust. Currently, the highly caustic seep water stream emanating from this subsurface drainage system is neutralized in-line with concentrated sulfuric acid and then discharged to the City of Petoskey's publicly owned treatment works (POTW). Up to a maximum of 30,000 gallons per day (GPD) may be discharged to the POTW during the peak flow summer months, while a maximum of 20,000 GPD may be discharged to the POTW during the winter months.

Within the past year, CMS has installed additional seep water collection systems in the vicinity of the CKD stock piles in order to collect any CKD leachate that may have been bypassing the original subsurface drainage system. The seep water collected in the new collection systems is neutralized and then trucked off-site for disposal in a licensed underground injection well. Seep water collected in the new collection systems was not part of the pilot scale testing program.

The pilot scale work was performed at the Bay Harbor Pretreatment Facility located in Emmet County, Michigan over the course of a six week period in November – December 2005, using neutralized seep water produced by the aforementioned in-line neutralization system. The pilot scale studies were designed and performed by Parsons, while analytical services and results were provided by Consumers Energy Laboratory Services or its subcontractors.

The pilot scale treatability studies were a continuation of the bench scale testing used to develop the conceptual design report submitted to the City of Petoskey in October 2004. Additional bench scale testing, completed in June 2005, further refined key process design parameters. The pilot testing also fulfilled the requirements of the State of Michigan - City of Petoskey Administrative Consent Order No. 01-001-003.

SECTION 2.0 BACKGROUND

2.1 BACKGROUND

The Bay Harbor seep water has a dark brown color and is characterized by high pH and alkalinity, high dissolved solids (predominantly potassium sulfate), moderate dissolved concentrations of aluminum (Al) and silicon (Si), trace concentrations of arsenic (As), manganese (Mn), mercury (Hg), vanadium (V) and nickel (Ni), low concentrations of nutrients, high chemical oxygen demand (COD) and total organic carbon (TOC), and comparatively low biochemical oxygen demand (BOD). The pH, dissolved solids, and trace metals are typical of CKD leachate. The color, TOC and COD are thought to be from dissolved organic acids (fulvic, humic, tannic and others) that originated from decaying organic matter in the cedar swamp into which the CKD was originally placed.

The existing Bay Harbor Pretreatment Facility is unable to consistently meet the City of Petoskey's Nondomestic User Discharge Permit limits for As and Hg, and is also subject to severe scaling problems from the precipitation of aluminosilicate solids in the discharge line. Parsons had previously designed and performed various bench scale treatability tests with the seep water to address these existing problems. **Table 2.1** includes a summary of the characteristics of the raw Bay Harbor seep water and the current permitted pretreatment discharge limits.

2.1.1 Bench Scale Tests

The first round of treatability testing focused on the development of a cost-effective treatment process to: 1) meet the City of Petoskey's Nondomestic User Discharge Permit (i.e. pre-treatment permit) limits by neutralizing the pH and reducing the concentrations of As, Hg, and COD; and 2) reduce the potential for downstream scaling to occur by removing some of the dissolved Al and Si. It was demonstrated that a conventional coagulation-flocculation-sedimentation process using aluminum sulfate (alum) with a cationic polymer flocculant aid could be used to effectively meet these goals.

Table 2.2 summarizes some results from bench scale tests which involved pH adjustment of the seep water, followed by reaction with alum or polyaluminum chloride (PAC). Solids were allowed to settle and the decant was then filtered thru 5, 1 and 0.45 micron filters. These tests demonstrated that Hg could be captured in a particulate phase thru precipitation / coagulation with alum or PAC, but very high doses of coagulant and a cationic polyelectrolyte flocculant would be required to form solids that could be separated via gravity. The filtration tests demonstrated that the particulate phase that formed was between 0.45 and 1 micron in size. For example, mercury was reduced from 500 ng/L to 110 ng/L after treatment with alum and filtration on a 0.45 micron filter.

Given the dispersed nature and size of the solids formed in this matrix, it was determined that a conventional filtration process (multimedia, cartridge or bag) would be unable to significantly remove precipitated mercury from the seep water. As a result, bench scale testing of a membrane ultrafiltration (UF) process was pursued. The UF membrane

utilized for this testing had an effective pore size of less than 0.1 microns. The pre-treatment prior to ultrafiltration consisted of pH adjustment to pH 7.5 and chemical coagulation using alum, PAC, and/or a heavy metal precipitant marketed by Nalco for mercury precipitation (Nalmet 1689).

Key results from the bench scale UF testing are summarized in **Table 2.3**. The results demonstrated that pH adjustment alone followed by UF filtration could reduce mercury from an initial concentration of 700 ng/L to 200 ng/L. Treatment with Nalmet prior to UF filtration improved Hg removal, producing effluent concentrations in the 20 to 30 ng/L range. Alum and PAC pre-treatment slightly improved Hg removal (compared to no pre-treatment), although Nalmet addition (with alum or PAC) was required to achieve the lowest Hg concentrations. Alum or PAC was required to achieve significant reductions in dissolved silica (responsible for downstream scaling problems) and other metals present in the CKD matrix, including arsenic. The optimal pre-treatment conditions were identified as 1) pH adjustment to pH 7.5, 2) coagulation / precipitation with alum and Nalmet, followed by UF filtration.

2.1.2 Pilot Scale Tests

To confirm the results of bench scale testing, to develop full scale design parameters, and to fulfill the requirements of the consent order, Parsons conducted pilot testing of both the conventional sedimentation process and a tubular UF membrane filtration process. Several pre-treatment conditions were tested including reaction pH, alum dose, and Nalmet dose. Key parameters related to the conventional sedimentation and UF membrane filtration process were also evaluated.

TABLE 2.1
TYPICAL BAY HARBOR SEEP WATER CHARACTERISTICS AND POTW
DISCHARGE PERMIT LIMITS

Constituent	Abbr.	Unit	Raw Seep	Permit Limit
General:				
Alkalinity – Total	Alk	mg/L	5,000	-
Total Organic Carbon	TOC	mg/L	350	-
Total Inorganic Carbon	TIC	mg/L	50	-
Total Dissolved Solids	TDS	mg/L	32,000	-
Total Suspended Solids	TSS	mg/L	20	300
pH	pH	s.u.	12.5	6.5 – 9.5
Temperature	Temp	°C	20	-
Oxygen Demand:				
Biochemical Oxygen Demand	BOD ₅	mg/L	75	-
Chemical Oxygen demand	COD	mg/L	800	700
Total Metals:				
Aluminum	Al	mg/L	25	-
Antimony	Sb	mg/L	<0.05	-
Arsenic	As	mg/L	0.25	0.20
Barium	Ba	mg/L	0.025	-
Beryllium	Be	mg/L	<0.005	-
Cadmium	Cd	mg/L	<0.001	0.022
Chromium, Total ³	Cr	mg/L	0.03	4.40
Cobalt	Co	mg/L	<0.015	-
Copper	Cu	mg/L	0.04	0.17
Iron	Fe	mg/L	1.5	-
Lead	Pb	mg/L	0.001	0.47
Mercury	Hg	ng/L	700	<200
Manganese	Mn	mg/L	0.1	-
Nickel	Ni	mg/L	0.25	1.20
Selenium	Se	mg/L	0.08	-
Silicon (as SiO ₂)	SiO ₂	mg/L	70	-
Silver	Ag	mg/L	<0.0005	0.091
Strontium	Sr	mg/L	0.07	-
Zinc	Zn	mg/L	0.1	0.870
Alkali Cations:				
Calcium	Ca ²⁺	mg/L	20	-
Magnesium	Mg ²⁺	mg/L	<0.5	-
Potassium	K ⁺	mg/L	15,000	-
Sodium	Na ⁺	mg/L	1,000	-
Anions:				
Bromide	Br ⁻	mg/L	15	-
Chloride	Cl ⁻	mg/L	2,000	-
Fluoride	F ⁻	mg/L	20	-
Sulfate	SO ₄ ²⁻	mg/L	12,000	-

TABLE 2.2
KEY RESULTS FROM INITIAL BAY HARBOR SEEP WATER BENCH SCALE TESTING

#	Coag. Dose (mM Al)	Coag. Type	Chemical Doses / Observations	Sample #	COD	TSS	Al (mg/L)	As (mg/L)	Hg (ng/L)	SiO ₂ (mg/L)
RAW SEEP	-	-	Adjust Raw Seep to pH 7.5 and then filter through 0.45 micron filter.	RAW SEEP	743	5	16.2	0.19	500	58.4
				pH 7.5	721	X	13.5	0.18	500	55.3
				FILT-0.45	688	-	8.17	0.19	500	33.8
E102	6	PAC (P430)	6 mM as Al with PAC (1200 ppm Chemco P-430); no polymer. Small, pinpoint floc during flocculation. Solids settle well. Sludge blanket ~200 mL after 4 minutes settling. Decant dark brown. Sludge volume after 30 minutes settling ~200 mL. Some solids retained on W40. Slow filtration through 0.45 micron. Filtrate lighter in color. Sludge filtered slowly through Whatman No. 5; cake layer on filter at end. Filtrate dark brown / reddish and free of solids.	SLUR	-	1350	-	-	-	-
				DEC	655	298	33.7	0.06	500	46.9
				FILT-W40	576	255	30.4	0.05	480	45.3
				FILT-0.45	749	-	2.4	0.04	290	20.0
E103	6	Alum	6 mM as Al with Alum; no polymer. Small particles observed during flocculation; not settling noticeably after mixer turned off. A distinct sludge blanket at 500 mL observed at 16 and 30 minutes. Cloudy dark brown decant. After 45 minutes, blanket ~350 mL. Some solids retained on W40. Slow filtration through 0.45 micron. Filtrate much lighter in color than E102. Sludge filtered fast through Whatman No. 5, few solids retained on filter, filtrate dark brown and very turbid.	SLUR	-	815	-	-	-	-
				DEC	638	143	92.5	0.10	350	34.4
				FILT-W40	982	210	91.9	0.10	340	34.6
				FILT-0.45	415	-	1.29	0.02	110	9.3
E109	6	Alum	6 mM as Al with Alum; 100 ppm cationic poly P-250HV. Perceptible discreet flocs larger than E107. Sludge front observed during settling, sludge blanket at 0.8 L after 30 minutes, 0.68L after 45 minutes. Decant clear, light brown / orange. Filtration through W40 fast, few solids retained. Filter through 0.45 micron slow but faster compared to E107. Filtrate yellowish, lighter than 105, 107, 109A. Sludge initially filtered fast through Whatman No. 5 (with lots of solids passing thru) but then filtration slowed down as cake layer built up on filter.	SLUR	-	840	-	-	-	-
				DEC	451	71	4.4	0.03	70	8.4
				FILT-W40	545	69	4.1	0.03	70	7.9
				FILT-0.45	501	-	1.0	0.02	60	6.3
E116	6	PAC (P430)	6 mM as Al with PAC; 10 ppm Nalmet; 100 ppm cationic Poly P-250HV. Flocculant, defined sludge blanket during settling, decant somewhat turbid with lot of smallish flocs. Sludge blanket at 0.22 L after 30 minutes. Relatively many solids retained on W40 (less than E117, more than E115 and E114), filtered through 0.45 micron relatively fast.	SLUR	-	1380	-	-	-	-
				DEC	496	110	8.85	0.04	80	26.4
				FILT-W40	478	81	6.38	0.04	90	27.4
				FILT-0.45	476	-	1.23	0.03	40	22.7

TABLE 2.2 (CONT'D)
KEY RESULTS FROM INITIAL BAY HARBOR SEEP WATER BENCH SCALE TESTING

#	Coag. Dose (mM Al)	Coag. Type	Chemical Doses / Observations	Sample #	COD	TSS	Al (mg/L)	As (mg/L)	Hg (ng/L)	SiO ₂ (mg/L)
E117	6	PAC (P430)	6 mM as Al with PAC; 10 ppm Nalmet; no cationic Poly. Only small flocs formed, with very turbid decant during settling; settled sludge blanket at 0.1L after 30 minutes, dark brown turbid decant. A lot of solids retained on W40 (most of E114-E117), filtered through 0.45 micron relatively fast. Sludge filtered slowly on Whatman No. 5. Cake solids on filter. Filtrate free of solids, dark brown / red in color.	SLUR	-	1230	-	-	-	-
				DEC	718	690	70.9	0.08	430	41.2
				FILT-W40	766	500	69.8	0.08	430	40.4
				FILT-0.45	543	-	3.47	0.04	80	23.0

Sample # key:

SLUR= Sample collected during flocculation for suspended solids analysis

DEC = Sample top 1L of decant after settling solids

FILT-W40 = Filtrate of Decant through Whatman 40 Filter (nominal pore size 8 micron)

FILT-0.45 = Filtrate of FILT-W40 through 0.45 micron filter

TABLE 2.3
RESULTS FROM BAY HARBOR SEEP WATER BENCH SCALE TESTING OF THE
ULTRAFILTRATION PROCESS

		TOC mg/L	COD mg/L	Al mg/L	As mg/L	Hg ng/L	SiO ₂ mg/L
Untreated Seep		350	780	13.4	0.200	700	58.8
pH Neutralized		250	545	3.33	0.174	200	20.5
Nalmet Only							
Nalmet Dose (ppm)	0	250	545	3.33	0.174	200	20.5
	10	200	450	2.04	0.168	25.9*	18.7
	50	200	460	2.18	0.164	16.6*	20.0
Alum Only							
Alum Dose (mM)	0	250	545	3.33	0.174	200	20.5
	1	190	455	3.64	0.105	160	10.2
	3	160	390	2.1	0.054	120	7.3
	6	170	390	1.42	0.031	190	5.2
Alum or PAC w / 1 ppm Nalmet							
Alum Dose (mM)	1	190	440	3.04	0.114	130	8.5
	3	170	380	1.91	0.052	120	5.6
PAC Dose (mM)	1	200	445	1.59	0.121	120	16.1
	3	170	390	1.01	0.068	130	15.8
Alum or PAC w / 10 ppm Nalmet							
Alum Dose (mM)	0	200	450	2.04	0.168	25.9*	18.7
	1	190	455	3.42	0.109	26.6*	9.3
	3	170	400	2.01	0.055	120	6.6
PAC Dose (mM)	1	190	435	1.49	0.116	100	16.7
	3	170	405	1.01	0.066	22.8*	16.0
	6	180	415	1.3	0.040	110	17.4
1 mM Alum w / Nalmet							
Nalmet Dose (ppm)	0	190	455	3.64	0.105	160	10.2
	1	190	440	3.04	0.114	130	8.5
	10	190	455	3.42	0.109	26.6*	9.3
3 mM Alum w / Nalmet							
Nalmet Dose (ppm)	0	160	390	2.1	0.054	120	7.3
	1	170	380	1.91	0.052	120	5.6
	10	170	400	2.01	0.055	120	6.6
	50	170	390	2.09	0.052	19.4*	5.3

Note: All experiments run at pH 7.5

* Samples analyzed for low level Hg by Method 1631

2.2 MAJOR PILOT TEST EQUIPMENT

The pilot scale system consisted of the following major components:

- Two feed tanks (275 gallon) with mounted propeller type mixers (1/2 hp) for batch pH adjustment and to feed the rest of the pilot treatment equipment.
- Progressive cavity feed pump (nominal 10 gpm), flow meter, and recycle lines.
- Two flash mix reactors (nominal 55 gallon) with mounted propeller type mixers (1/4 hp).
- One inclined plate clarifier skid (8 gpm maximum at 0.25 gpm/ft²) with flocculation tank (nominal 150 gallon), mixer (3/4 hp), sludge transfer pump (10 gpm air diaphragm), three chemical metering pumps (2 gph), and a control panel (120v, 1ph, 60hz).
- One ultrafiltration skid (1-inch PVDF tubular membranes with 13.2 ft² of surface area), feed tank (350 gallon), circulation pump (40 gpm, 5 hp), wash tank (20 gallon), permeate flow meter, and control panel (208v, 3ph, 60hz).
- One sludge storage tank (nominal 100 gallons).
- One receiver mounted compressor (11.3 cfm at 40 psig) with 60-gallon tank.
- Interconnecting piping, fittings, valves, wiring, and equipment supports.

The use of the dual feed tanks provided sufficient isolation of the pilot from the existing pretreatment system. The pH was further adjusted to the desired value in the dual feed tanks. From these tanks the water was pumped through the two mechanically mixed 55-gallon reactors. The water level in each of the 55 gallon reactors was set at approximately 40 gallons by the overflow pipe. Alum addition occurred in the first reactor while Nalmet or cationic polymer (Chemco P-250HV) was added to the second reactor. During testing of the UF system, the flow rate thru the reactors was set at 3.5 gpm giving a hydraulic residence time (HRT) in each reactor of approximately 11 minutes. During testing of the clarifier, the flow rate thru the reactors was set at approximately 2.0 gpm, giving a HRT of approximately 20 minutes in each reactor and a clarifier loading rate of 0.075 gpm / ft².

During UF testing, the pH adjusted and chemically-treated seep water was pumped from the chemical reactors into the 350-gallon UF feed tank (bypassing the clarifier skid). Permeate from the UF was drained to the sludge storage tank, from where it was periodically pumped to existing seep storage tanks for eventual off-site disposal. The UF concentrate was also transferred to the sludge storage tank, from where it was periodically pumped to existing seep storage tanks for eventual off-site disposal.

During testing of the conventional sedimentation process, water from the second chemical reactor flowed by gravity directly into the clarifier flocculation tank with a hydraulic retention time of 30 to 60 minutes. From the flocculation tank, the seep water flowed into the clarifier for gravity separation of suspended solids. The clarifier overflowed to an effluent line which discharged to a floor drain connected to the building sump. Settled solids were

periodically pumped from the clarifier hopper into the sludge storage tank, from where the solids were periodically pumped to existing seep storage tanks for off-site disposal.

The pilot system equipment P&ID is depicted in **Figure 2.1**.

FIGURE 2.1 PILOT SYSTEM P&ID

SECTION 3.0 MEMBRANE ULTRAFILTRATION TESTING

3.1 BACKGROUND

3.1.1 Technology Description

Membrane ultrafiltration (UF) is a continuous, industrial-scale process for separating high molecular weight, colloidal, or suspended solids from fluid streams. The key to the process is a thin, polymeric, semi-permeable membrane. The feed solution is pumped at low pressures across the surface of the membrane. Solutes whose sizes are greater than the pore size of the membrane and all suspended solids are retained and concentrated. Water, salts, and small molecular weight constituents pass through, or permeate, the membrane. Concentration of the UF feed stream is accomplished by pumping from a tank thru the membrane modules. The components rejected by the membrane are circulated back to the feed tank and are periodically wasted. The components that pass through the membrane are sent to a hold tank or are directly discharged as treated effluent. The extent of feed water concentration in the feed tank is determined by the concentration factor, which is calculated by dividing the cumulative volume of water added to the feed tank by the volume of water remaining in the feed tank.

Five major operational parameters directly affect the permeate rate (flux) and effluent quality when ultrafiltering process streams:

- Solids concentration of the feed (or the concentration factor), and/or the pre-treatment procedures employed;
- Average system pressure;
- Membrane fouling and recovery via cleaning;
- Temperature of the feed; and
- Material of construction and molecular weight cut-off (pore size) of the membrane.

The membrane material (PVDF) and minimum molecular weight cut off (75,000 atomic mass units) were selected based on bench-scale testing results and consultations with the membrane system vendor who supplied the skid. Temperature adjustment (higher temperatures generally result in higher flux rates) is not desirable for the full scale system due to the energy costs associated with heating the seep water. Therefore, pilot testing focused primarily on optimizing the first three parameters above, as well as demonstrating consistent compliance with the City's pre-treatment requirements.

3.1.2 Objectives

The primary objectives for UF pilot testing are summarized below:

- *Determine flux and permeate quality relationships for a variety of seep water pre-treatment conditions.* Several pre-treatment conditions were tested to determine how membrane performance (flux) was affected.

- *Establish maximum concentration factors.* The objective is to push the membrane system to its maximum achievable concentration factor while measuring flux rates and permeate quality. The maximum concentration achievable correlates with the maximum achievable total solids concentration which controls the concentrate waste volume and rate.
- *Optimize membrane cleaning procedures.* Different cleaning solutions can be utilized to recover membrane flux after each pilot run, including detergents, caustic, acid, and hypochlorite solutions. Several cleaning solutions were tested during pilot testing in order to determine the required cleaning method for this water.
- *Demonstrate satisfactory UF performance over several processing intervals.* After optimization of pre-treatment parameters, concentration factors, and cleaning methods, the pilot test was operated for 3 consecutive days for 8 hrs/day to demonstrate continuous operation and ensure compliance with the City's pre-treatment requirements.

3.1.3 Testing Summary

Included in **Table 3.1** is a summary of the individual tests performed during pilot testing of the membrane ultrafiltration process. A copy of the UF system data log is included in **Appendix A**, and a summary of the pilot test analytical results is included in **Appendix B**. The basic procedure for each test was to first adjust the pH of the neutralized seep in the seep water feed tanks. From the feed tanks, the neutralized seep was pumped at a rate of 3.5 gpm thru the alum and Nalmet reactors and into the UF feed tank. When the UF feed tank was full (~300 gallons), the UF pump was started. The pump throttling valve was opened fully, resulting in a discharge pressure that ranged between 46 and 48 psi. The backpressure on the membrane was maintained at 1.5 psi, giving an average transmembrane pressure of 31-32 psi. UF permeate was collected either in the sludge tank (which was pumped to the holding tanks for off-site disposal) or sent to the building drain for discharge to the city.

As the level in the UF feed tank dropped, pre-treated seep would periodically be added to replenish the volume in the feed tank. At the end of the test, the UF feed tank was batched down to approximately 30 gallons. The concentrated seep would then be transferred to the 20 gallon wash tank from where it would be pumped thru the membranes for further concentration. This allowed the seep to be concentrated up to 40X for each test run. Samples of the UF permeate and UF feed would be collected several times during each test run. Gauge pressures, permeate flow rates, and the UF feed temperatures were regularly recorded. Temperature increased with time due to energy imparted to the seep water from the UF system pump and friction thru the membranes.

TABLE 3.1
SUMMARY OF MEMBRANE ULTRAFILTRATION TESTS
BAY HARBOR SEEP WATER

Test #	pH	Alum Dose (mM Al)	Nalmet Dose (ppm)	Notes / Membrane Cleaning Comments
UF01-UF03	8.3	1	-	Cleaned membrane with Memclean (a detergent) at neutral pH, then caustic (to pH 11)+chlorine+spongeballs, and then low pH (4.5) + chlorine. Flux only partially recovered.
UF04	7.15	1	-	Cleaned membrane first with sponge balls + water, then with acid solution (to pH 4.5) + bleach (750 mL), then water and bleach. Flux only partially recovered.
UF05	7.65	1	1	Cleaned membrane with acidic solution (pH to 4.5). Then 3 cleanings with sponge balls + water. Then pH 4.0 solution with bleach. Flux only partially recovered.
UF06	7.0	0.7	-	Cleaned membrane with bleach at pH 4.0 (left running overnight). Flux only partially recovered.
UF07	7.5 - 8.0	0.7	5 to 12	pH increased with time. Nalmet dose increased inadvertently during test. Membrane cleaned with Memclean A (buffered acid solution) and sponge balls. More flux recovered than previous attempts
UF08	8.1	0.85	5	Test utilized concentrate from UF04 - UF07. Chemical doses represent averages from these prior tests. Membrane cleaned with Memclean A and sponge balls followed by caustic w/ chlorine. Best flux recovery achieved.
UF09	7.5	1	1	3 day confirmatory test; membrane cleaned with Memclean A (no sponge balls) and then caustic + chlorine. Final cleaning with Memclean A solution (no sponge balls). Partial flux recovery.
UF10	7	1 to 2	1 to 2	Alum and Nalmet dose increased inadvertently during test run. Membrane cleaned with Memclean A acid solution only. Partial flux recovery.
UF11	7.5 - 8.0	0.5	50	pH increased with time. Membrane cleaned with Memclean A acid solution and sponge balls. Excellent flux recovery.
UF12	7.8	-	-	Seep pre-treated with 75 ppm MCX (a product similar to Nalmet) and 5 micron filtration prior to UF (Ish Inc. testing). Membrane cleaned with Memclean A acid solution + sponge balls, then caustic w/ chlorine.

3.2 PILOT TEST RESULTS

3.2.1 Membrane Flux

The initial clean water flux for the new membrane at the start of the pilot test was 361 gallons per square foot per day (gfd). The flux during treatment of the Bay Harbor Resort seep was approximately 10X lower than this value, generally ranging from 20 – 40 gfd. The results for flux, temperature, and concentration factor from each UF test are summarized in **Figures 3.1 thru 3.10**. The observed flux rate thru the UF membrane was affected by the

pre-treatment conditions employed, seep water temperature, and to a lesser degree, the concentration factor of the seep.

Due to the fact that the optimal membrane cleaning procedures were not identified until after UF08 (as discussed in Section 3.2.2), it is difficult to draw firm conclusions regarding the effect of every pre-treatment condition on flux performance. This is because the membrane was not fully recovered prior to several of the test runs, which means the fouling from the prior run(s) could have influenced the flux rates. The membrane can be considered cleanest for UF01-UF03, UF09, and UF12. The membrane was partially cleaned prior to all other test runs, except UF11. Nevertheless, the following observations are possible:

- Flux rates declined rapidly after starting UF treatment of the seep water, leveling off at 20 – 30 gfd within 5 to 10 hours.
- Higher seep water pH generally resulted in more rapidly declining and lower flux rates.
- Cleaning the membrane in the middle of a batch resulted in higher flux rates upon re-start and slower rates of decline compared to the start of a batch (see UF09 and UF11 for examples of this).
- The addition of fresh seep to the UF feed tank after membrane cleaning tended to cause the flux rates to decline more rapidly.
- The concentration factor had little effect on flux rates below a concentration factor of 50X (see UF08).
- Alum doses tested had little impact on flux rates.
- Flux rates generally increased with temperature, although not as significantly as observed with clean water, suggesting that membrane fouling largely controls flux.

These results indicate that the flux rates can be maximized by operating the pre-treatment process at a pH of around 7.0 rather than 8.0.

3.2.2 Membrane Cleaning and Flux Recovery

The fact that the flux rates declined much more slowly after membrane cleaning, suggests that the flux-limiting membrane foulant(s) is present at a low concentration and/or is rapidly removed from the feed solution onto the membrane surface during the first few hours of each test run. When the membrane is cleaned, this foulant is removed from the membrane (and the system), allowing much higher flux rates after re-start.

This behavior was observed when the membrane was cleaned with an acidic solution at pH 4.5 (made by adding sulfuric acid to city water) or using a dilute solution of Memclean A (US Filter), which is a buffered acid solution with a pH of 2.5. This suggests that the flux limiting foulant is inorganic. An organic foulant (such as NOM) would more likely be removed from the membrane by a high pH solution (by dissolution) or thru mechanical cleaning at low pH (by coagulation). However, the high concentration of organic material in the Bay Harbor seep water certainly also plays a role in membrane fouling, thru the formation of a gel layer on the membrane surface.

Given the presence of organic and inorganic foulants with different properties, a multi-step chemical and mechanical cleaning process was required to achieve full flux recovery. As summarized in **Table 3.1**, partial flux recovery was only achieved at the end of UF08, when the optimal cleaning method was identified. The optimal cleaning steps were identified as follows:

- *Step 1: Acid cleaning using a buffered acid solution around pH 2.5 (Memclean A).* This cleaning step likely removes metal ions (e.g. aluminum) and silica species on the membrane surface and/or within the membrane pore structure. The acidic pH also probably causes organics adsorbed onto the surface of the membrane to precipitate / coagulate somewhat, allowing them to be removed via mechanical cleaning.
- *Step 2: Mechanical cleaning.* This step utilizes sponge balls that scour the membrane surface to physically remove the adsorbed foulant. Sponge balls are loaded into a chamber downstream of the pump and allowed to pass thru the membranes. The sponge ball is captured by a basket strainer at the discharge to the wash tank. This cleaning step visibly causes a lot of brown "gunk" to be released into the UF wash tank, which is immediately followed by a large increase in flux. The brown gunk is the organic matter in the seep that has formed a gel layer on the membrane surface. Step 1 is critical prior to mechanical cleaning. No brown material was released and only a slightly small increase in the flux rate was observed when mechanical cleaning was performed at neutral or alkaline pH values. This supports the idea that the acidic pH helps weaken the bond between the adsorbed organics and the membrane surface and/or causes the adsorbed organics to coagulate which makes them easier to remove via scouring.
- *Step 3: Caustic cleaning at pH 11.5 with / without chlorine.* This step dissolves any remaining organic compounds on the surface of the membrane or within the membrane pores. If caustic cleaning is attempted prior to the acid and mechanical cleaning, the membrane flux actually worsens. This could be due to the re-precipitation of some aluminosilicate solids within the membrane pore structure. Whatever the cause, it is critical to perform the acid cleaning cycle and mechanical cleaning prior to caustic cleaning. The addition of bleach (chlorine) at high pH may improve the rate of membrane recovery.

These cleaning procedures allowed the clean water flux to return to 270 gfd. While this is approximately 75% of the original clean water flux of 361 gfd (the initial flux at the beginning of the test), this amount of flux recovery is typical for UF systems.

It was also found that much of the membrane flux could be recovered with the acid and mechanical cleaning cycles only (Step 1 and 2 above). For example, after UF 11 the clean water flux returned to 240 gfd without utilizing the caustic cleaning step (Step 3). These results indicate that Steps 1 and 2 will be required on a routine basis (every 24 to 48 hours), while the caustic cleaning cycle (Step 3) will be required less frequently (e.g. weekly or monthly).

3.2.3 Membrane Permeate Quality

The characteristics of the untreated Bay Harbor seep water are shown in **Table 3.2**. The characteristics of the raw seep did not substantially change during the pilot test. During operation of the UF membrane pilot system, samples of the UF feed and UF permeate were routinely collected for chemical oxygen demand, aluminum, arsenic, mercury, and silica analysis. These parameters were tracked closely because they are most important for compliance with the current discharge permit limits and to reduce downstream scaling. The quality of the UF permeate produced was affected by the pre-treatment conditions employed and the concentration factor at the time of sampling. Results are summarized in **Figures 3.11 thru 3.20** and discussed in the subsections below.

TABLE 3.2
CHARACTERISTICS OF UNTREATED BAY HARBOR SEEP WATER

Constituent	Abbr.	Unit	Average Value	Standard Deviation
Chemical Oxygen Demand	COD	mg/L	759	26
Aluminum	Al	mg/L	12.4	1.2
Arsenic	As	mg/L	0.186	0.004
Mercury	Hg	ng/L	500	20
Silica	SiO ₂	mg/L	72	7

Note: Average seep water characteristics from seep samples collected during UF01-UF03, UF04, UF05, and UF07

3.2.3.1 Chemical Oxygen Demand (COD)

The primary source of COD in the Bay Harbor seep water is natural organic matter, which also causes the dark brown color of the seep. UF permeate COD was affected in part by the seep pre-treatment method employed, but mostly by the concentration factor at the time of sampling. The following observations are noted:

- The concentration of COD in the untreated seep averaged 759 mg/L during the pilot test.
- The UF permeate COD concentration increased with the UF concentration factor. At the start of the UF test, permeate COD concentration ranged from 250 – 350 mg/L. The permeate COD increased by approximately 100 mg/L for every 10X increase in the concentration factor.
- The UF permeate became visibly darker beyond a concentration factor of 5 to 10, which is consistent with the increasing concentration in COD.
- Lower pH generally improved COD removal.
- Higher alum doses generally improved COD removal.
- One test (UF11) suggested that high doses of Nalmet improved COD removal.

3.2.3.2 Arsenic (As)

Arsenic removal was affected by the seep pre-treatment method employed and the concentration factor at the time of sampling. The following observations are noted:

- The concentration of arsenic in untreated Bay Harbor seep averaged 186 µg/L during pilot testing. Permeate concentrations at the beginning of a test ranged from 30 – 100 µg/L depending on the pre-treatment.
- Arsenic removal increased with alum dose and lower reaction pH. Nalmet had no discernible effect on arsenic removal.
- Permeate arsenic concentrations would sometimes increase with the concentration factor, although never beyond 100 µg/L. This increase in permeate arsenic concentration may in part be due to increasing pH, which also trended upward with the concentration factor during some tests.

3.2.3.3 Mercury (Hg)

Mercury removal was primarily influenced by the seep water pre-treatment method and the concentration factor at the time of sampling. The following observations are noted:

- The concentration of mercury in untreated Bay Harbor seep averaged 500 ng/L during pilot testing. Permeate mercury concentrations at the beginning of a UF test were always <100 ng/L. Low level mercury (method 1631) analysis indicate that initial permeate mercury concentrations were between approximately 10 and 30 ng/L, regardless of the pre-treatment method employed (refer to **Table 3.3** for further details).
- The concentration of mercury in the UF permeate consistently increased with the UF concentration factor. The amount of increase was inversely related to the Nalmet Dose (refer to UF7 and UF11 results in Table 3.3).
- The use of 10 to 50 mg/L of Nalmet improved mercury removal for a given concentration factor (refer to Table 3.4 for further details). The benefit was more pronounced at higher concentration factors.
- There was no clear relationship between alum dose or reaction pH on mercury removal, given the available data.

TABLE 3.3
SUMMARY OF LOW LEVEL (METHOD 1631) MERCURY RESULTS FROM UF
PERMEATE SAMPLES

Test Run	Treatment Conditions	Conc. Factor	UF Permeate Hg (ng/L)
UF01-03	pH = 8.3, alum = 1 mM as Al, Nalmet = 0 ppm	5.5	42.1
UF04	pH = 7.15, alum = 1 mM as Al, Nalmet = 0 ppm	2.6	31.7
UF05	pH = 7.65, alum = 1 mM as Al, Nalmet = 1 ppm	2.7	24.1
UF06	pH = 7.0, alum = 0.7 mM as Al, Nalmet = 0 ppm	3.9	28.2
UF07	pH = 7.5 - 8.0, alum = 0.7 mM as Al, Nalmet = 5 - 12 ppm	1.1	15.7
		2.4	14.2
		8.9	47.1
UF08	pH = 8.1; avg. alum dose = 0.85 mM as Al, avg. Nalmet dose = 5 ppm	18	67.6
		61.4	102
UF09	pH = 7.5, alum = 1 mM as Al, Nalmet = 1 ppm	1.9	21.0
		3.5	33.0
UF10	pH = 7.0, alum = 1-2 mM as Al, Nalmet = 1 - 2 ppm	2.2	23.4
UF11	pH = 7.5 - 8.0, alum = 0.5 mM as Al, Nalmet = 50 ppm	1.2	9.0
		4.5	11.2
		8.8	13.0
		46.4	19.7

TABLE 3.4
UF FEED AND UF PERMEATE MERCURY RESULTS AS A FUNCTION OF
NALMET DOSE

Nalmet Dose (ppm)	Test Run	Concentration Factor	UF Feed Hg (ng/L)	UF Permeate Hg (ng/L)
Low UF Concentration Factor				
0	UF04	2.6	1,140	31.7
1	UF05	2.7	1,180	24.1
1 - 2	UF10	2.2	780	23.4
5 – 12	UF07	2.4	1,012 ⁽¹⁾	14.2
50	UF11	1.2	970	9.0
		4.5	1,670	11.2
High UF Concentration Factor				
0	UF01-UF03	5.5	1,790 ⁽²⁾	42.1
5 - 12	UF07	8.9	3,600	47.1
50	UF11	8.8	2,780	13.0
		46.4	6,810	19.7

(1) UF Feed Hg concentration scaled up from 970 ng/L from sample collected at a UF concentration factor of 2.3.

(2) UF Feed Hg concentration calculated from linear regression using measured feed Hg concentration at concentration factors of 1.0, 1.8, 3.1, and 4.4 (measured values of 450, 700, 1060, and 1480 ng/L Hg, respectively)

3.2.3.4 Aluminum (Al)

The concentration of aluminum in untreated Bay Harbor seep averaged 12.4 mg/L. An additional 13 – 27 mg/L of aluminum (0.5 – 1 mM) was added to the seep in the form of alum during pre-treatment (except for UF 12 where no alum was added). The permeate concentration of aluminum generally ranged between 2 – 5 mg/L, increasing slightly with an increasing concentration factor. At the highest concentration factor achieved (UF08, CF = 169), the permeate aluminum concentration was 7.5 mg/L. There was no clear relationship between the pre-treatment method employed (reaction pH, alum and Nalmet dose) and UF permeate aluminum concentrations.

3.2.3.5 Silica (SiO₂)

The concentration of silica in untreated Bay Harbor seep averaged 72 mg/L as SiO₂. UF permeate silica concentrations were most affected by the alum dose employed and the reaction pH. Higher pH and higher alum dose resulted in lower permeate silica concentrations. Initial permeate concentrations ranged from 8 – 40 mg/L depending on the pre-treatment employed.

Unlike all other measured constituents, the permeate silica concentrations consistently decreased with increasing concentration factors. One reason for this behavior could be the increasing pH in the UF feed tank as the concentration factor increased. Another likely reason is that the ratio of aluminum to silica in the UF feed tank generally increased with time, because a larger percentage of aluminum was retained by the UF. As this ratio increased, the solubility of silica was reduced due to the precipitation of aluminosilicate solids which are then retained by the membrane.

3.2.3.6 Vanadium

Several samples were also analyzed for vanadium to evaluate its removal by the UF treatment process. The untreated Bay Harbor seep vanadium concentration was 0.190 mg/L. Permeate vanadium concentrations ranged from 0.090 – 0.180 mg/L depending only on the UF concentration factor. The increase in effluent concentration was approximately linear from a 1X to 10X concentration factor. Beyond a 10X concentration factor, the permeate vanadium concentration leveled off at approximately 0.180 mg/L. Alum dose and reaction pH appeared to have no effect on vanadium removal.

3.2.4 UF Concentrate

The UF concentrate was collected from test UF09 for the Michigan 10 TCLP analysis to confirm that the concentrated seep could be disposed offsite as characteristically non-hazardous waste under RCRA regulations. The seep was concentrated to a factor of 63X by the UF prior to analysis. The results are summarized in **Table 3.5**, along with the quantified total concentration for arsenic and mercury. The only detectable constituents via the TCLP analysis were arsenic and barium, which were well below the hazardous waste regulatory limits of 5.0 and 100 mg/L, respectively. Based on these results, there should be no issue with concentrating the Bay Harbor seep water as far as feasible for offsite disposal.

TABLE 3.5
MICHIGAN 10 TCLP RESULTS FOR CONCENTRATED
BAY HARBOR SEEP WATER

Metal	Abbr.	Unit	TCLP	Total	Limit
Arsenic	As	mg/L	0.012	2.27	5.0
Barium	Ba	mg/L	0.039	-	100
Cadmium	Cd	mg/L	< 0.005	-	1.0
Chromium	Cr	mg/L	< 0.02	-	5.0
Copper	Cu	mg/L	< 0.05	-	-
Lead	Pb	mg/L	< 0.01	-	5.0
Mercury	Hg	mg/L	< 0.001	0.0098	0.2
Selenium	Se	mg/L	< 0.10	-	1.0
Silver	Ag	mg/L	< 0.005	-	5.0
Zinc	Zn	mg/L	< 0.10	-	-

3.3 SUMMARY

Pilot testing of the UF membrane process demonstrated that it could be used to remove a significant amount of the COD, arsenic, mercury, and silica present in the Bay Harbor Resort seep water. The optimal pre-treatment conditions and design parameters for the UF membrane system are as follows:

- pH = 7.0 – 7.5
- Alum Dose = 1 mM as Al
- Nalmet Dose = 10 – 50 ppm
- Design Specific Flux = 0.87 gfd / psi
- Membrane Cleaning Requirements = acid cycle w/ mechanical cleaning every 24 – 48 hours w/ a final caustic + chlorine cleaning cycle (every 1 – 2 weeks).

The predicted average effluent characteristics of an UF membrane process with concentrations up to 10X are presented in **Table 3.6**.

While the characteristics depicted in **Table 3.6** contain predicted average effluent concentrations, it is important to keep in mind that there is a great deal of data scatter in the various concentration ranges. Therefore, it would be safe to say that the actual effluent concentrations may vary by as much as plus or minus 50%, depending upon the raw seep water constituent concentrations, the pretreatment methods employed, and the vagaries associated with the analytical methods used. In addition, there will be differences associated with the UF membranes employed, as the average pore size of UF membranes can vary by as much as plus or minus 10% within a manufacturer's production lot.

The performance of the UF membrane process in terms of effluent quality will also depend in part on the maximum concentration factor that the system is allowed to achieve. This is because as the seep becomes more concentrated, the effluent quality changes. For instance, aluminum and mercury appear to increase slightly with increasing concentration factor, while arsenic appears to level off and stay at a constant level, and silica appears to decrease with increasing concentration factor.

In addition, as the seep water becomes more concentrated, the volume of the UF concentrate stream requiring offsite disposal reduces. At an UF concentration factor of 10X, 10 gallons of concentrated seep will require offsite disposal for every 100 gallons of raw seep water treated, while at a concentration factor of 50X, only 2 gallons of concentrated seep will require offsite disposal. Therefore, in order to ensure the economic feasibility of the UF membrane process, the concentration factor should be made as high as possible without exceeding the discharge limits.

TABLE 3.6
PREDICTED AVERAGE EFFLUENT CHARACTERISTICS FOR TREATMENT OF
BAY HARBOR SEEP WATER USING AN UF MEMBRANE PROCESS WITH
CONCENTRATION TO 10X

Constituent	Abbr.	Unit	Value	Current Permit Limit
pH	pH	s.u.	7.0 – 7.5	6.5 – 9.5
Chemical Oxygen Demand	COD	mg/L	400	700
Total Suspended Solids	TSS	mg/L	<10	300
Color	Color	color units	1400	-
Aluminum	Al	mg/L	3.0	-
Arsenic	As	mg/L	0.085	0.20
Cadmium	Cd	mg/L	< 0.01	0.022
Copper	Cu	mg/L	0.05	0.17
Lead	Pb	mg/L	< 0.01	0.47
Mercury	Hg	ng/L	30	<200
Nickel	Ni	mg/L	0.10	1.20
Silica	SiO ₂	mg/L	30	-
Silver	Ag	mg/L	< 0.005	0.091
Vanadium	V	mg/L	0.12	-
Zinc	Zn	mg/L	0.02	0.870

Note: Predicted effluent values based on UF09 analytical results.

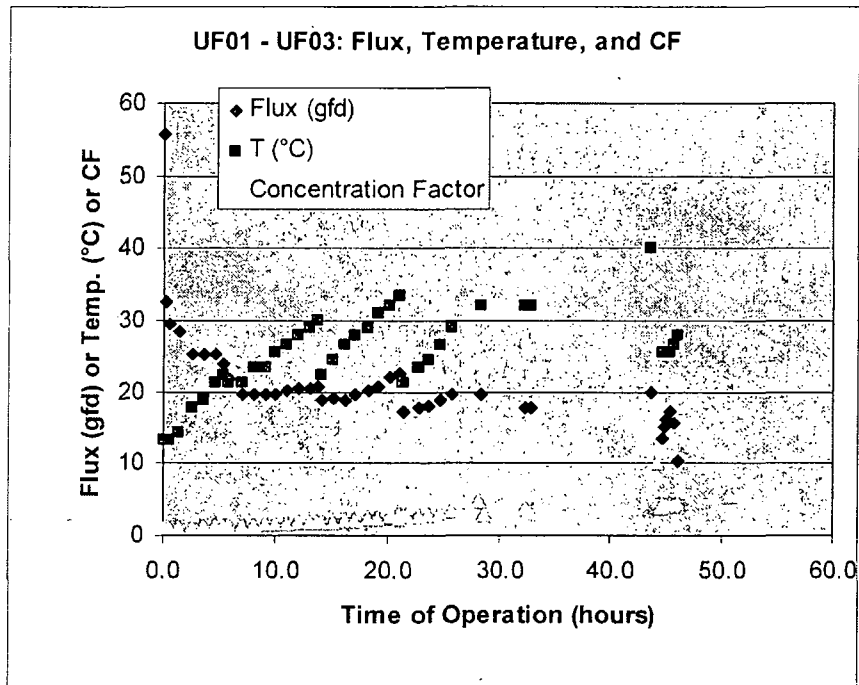


Figure 3.1 – UF01-UF03 flux, temperature, and concentration factor results.

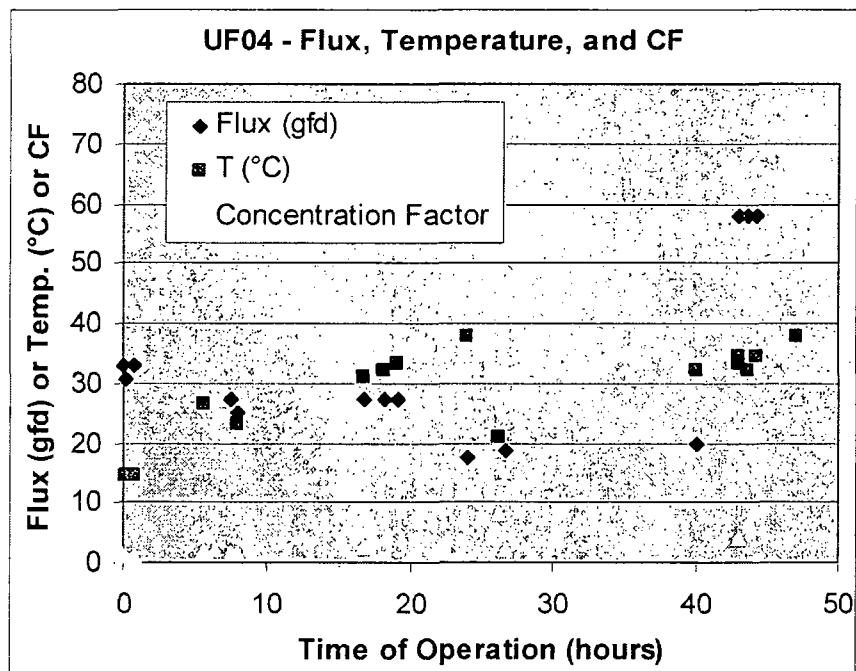


Figure 3.2 – UF04 flux, temperature, and concentration factor results. Flux increase at hour 43 due to membrane cleaning.

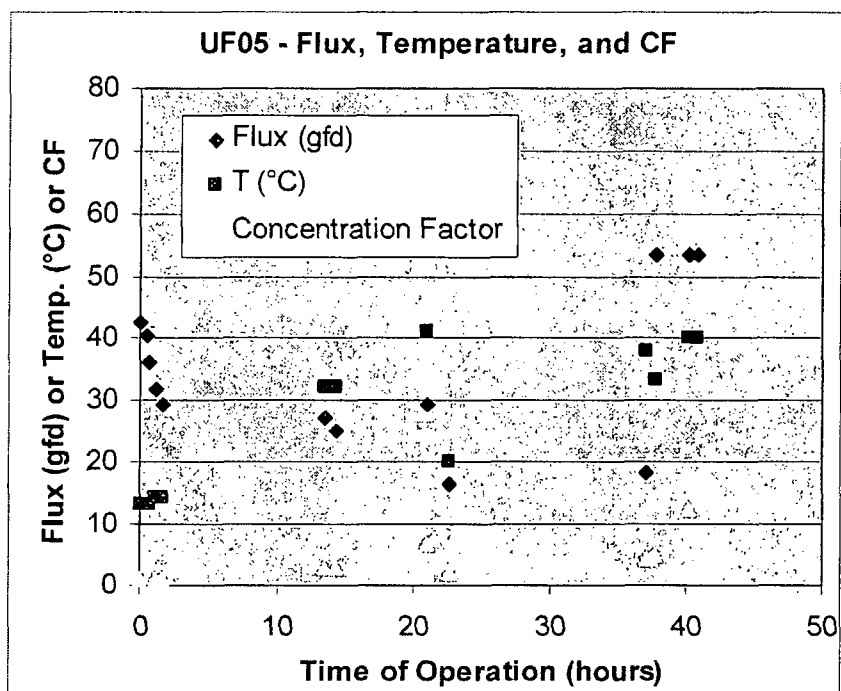


Figure 3.3 – UF05 flux, temperature, and concentration factor results. Flux increase at hour 37 due to membrane cleaning.

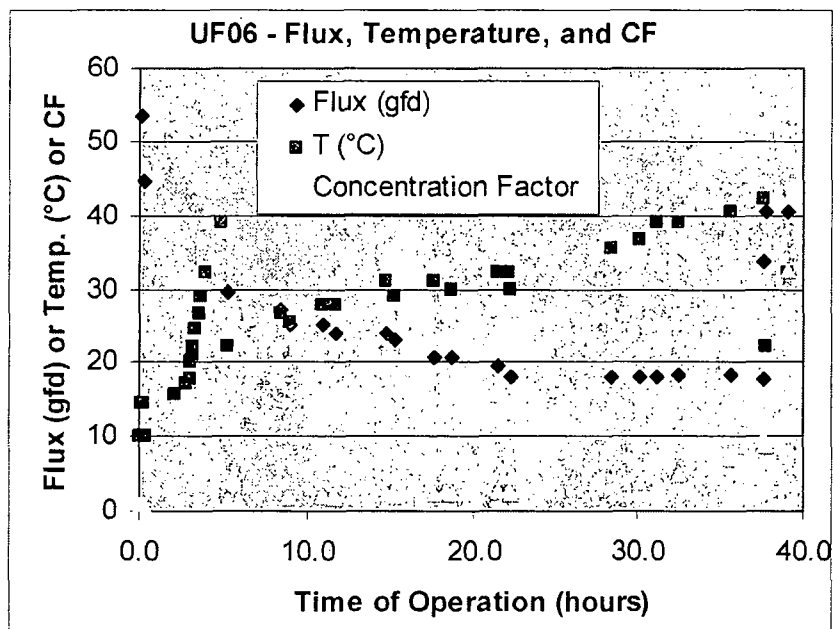


Figure 3.4 – UF06 flux, temperature, and concentration factor results. Flux increase at hour 38 due to membrane cleaning.

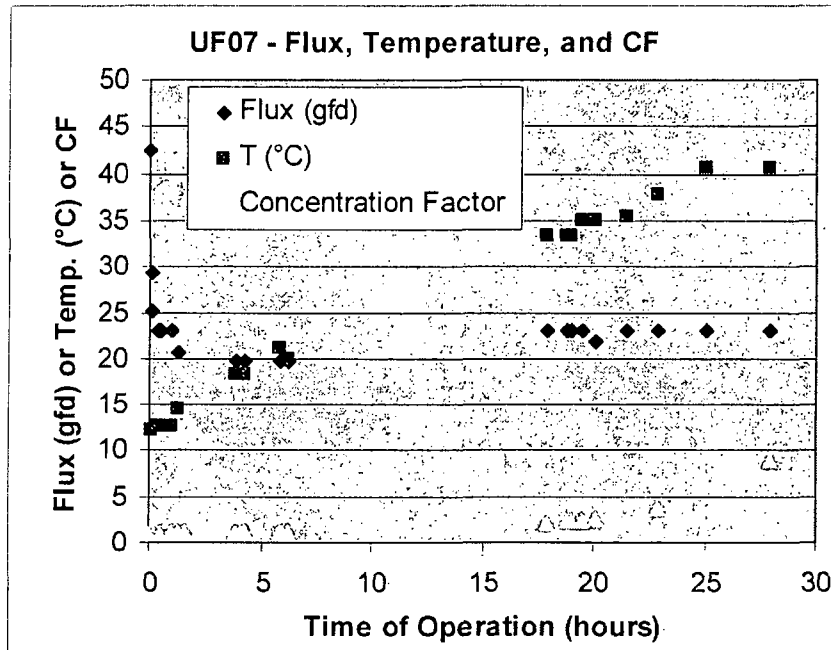


Figure 3.5 – UF07 flux, temperature, and concentration factor results. Membrane was cleaned after the test was completed.

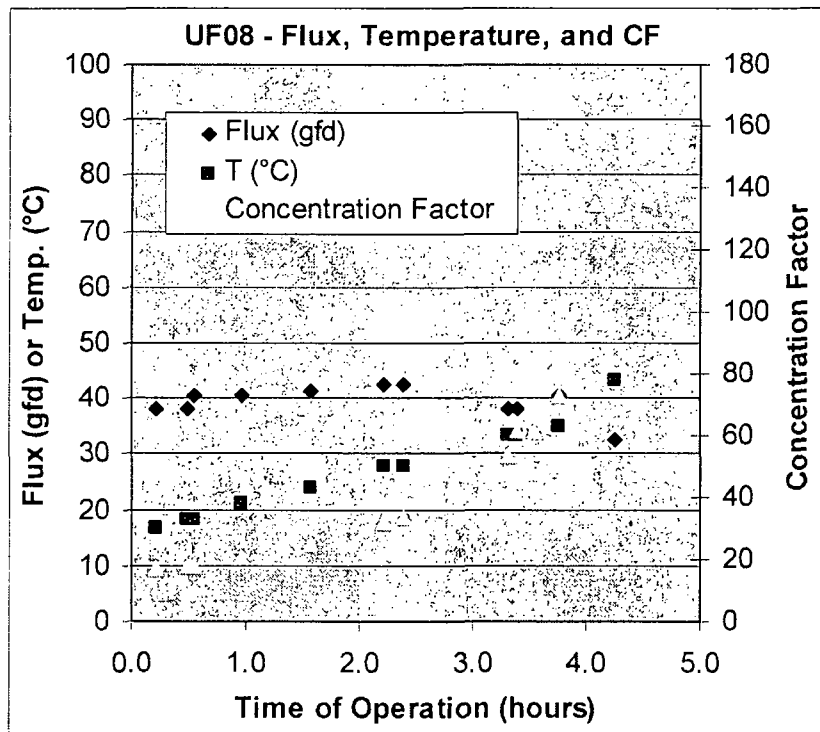


Figure 3.6 – UF08 flux, temperature, and concentration factor results. Membrane was cleaned after the test was completed.

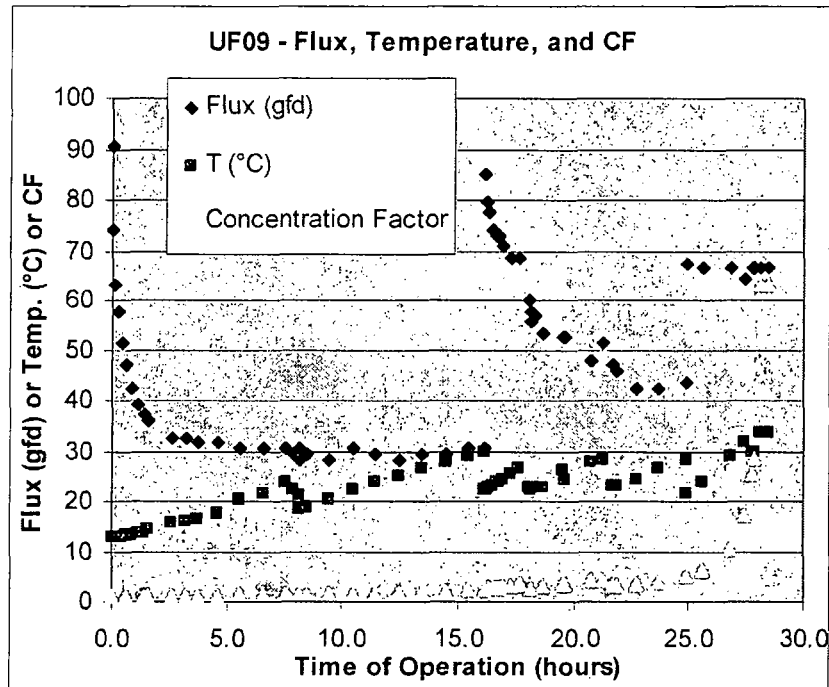


Figure 3.7 – UF09 flux, temperature, and concentration factor results. Flux increase at hour 16 and 25 due to membrane cleaning.

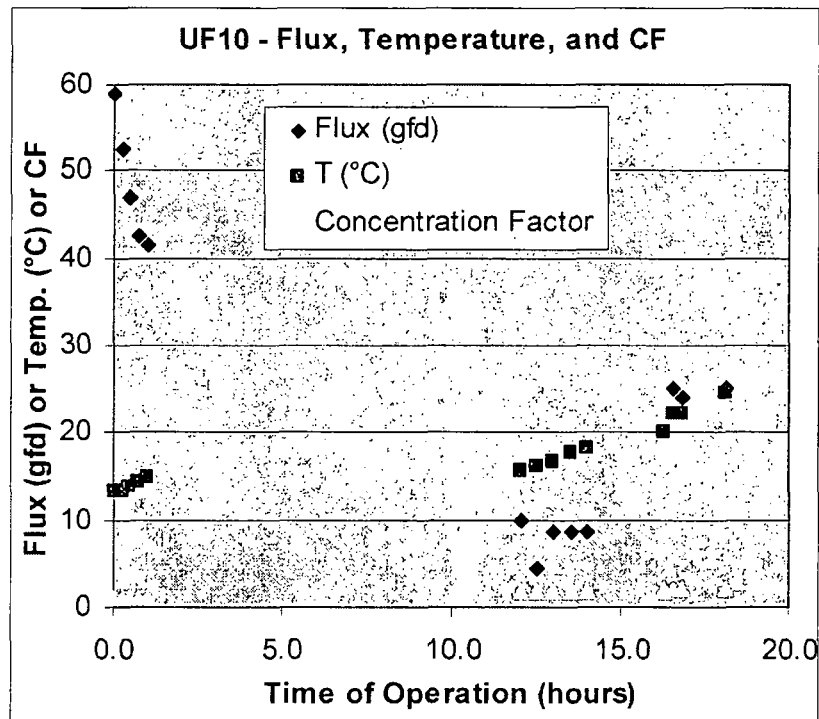


Figure 3.8– UF10 flux, temperature, and concentration factor results. Flux increase at hour 17 due to membrane cleaning.

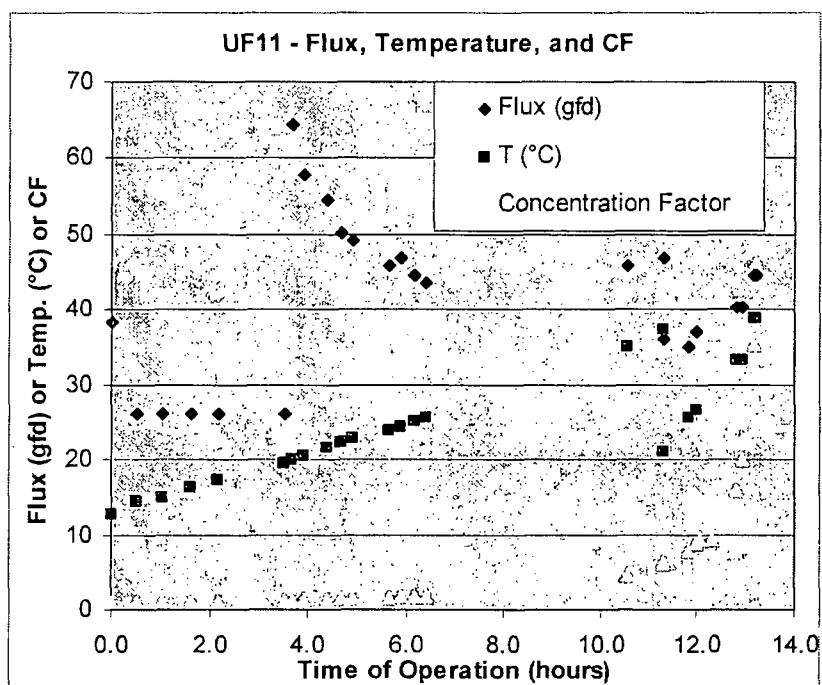


Figure 3.9 – UF11 flux, temperature, and concentration factor results. Flux increase at hour 4 due to membrane cleaning (membrane was not cleaned between the end of UF10 and start of UF11).

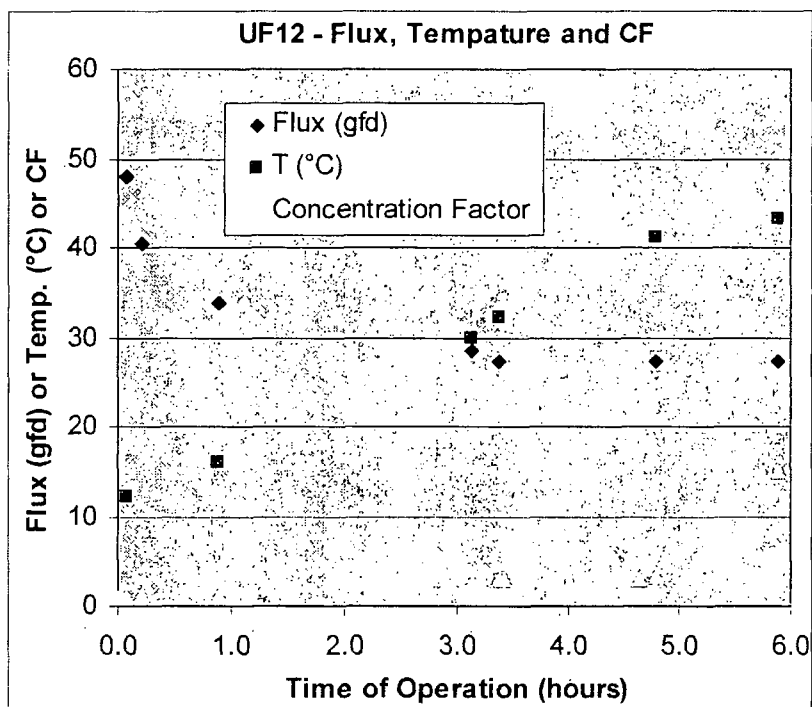


Figure 3.10 – UF12 flux, temperature, and concentration factor results.

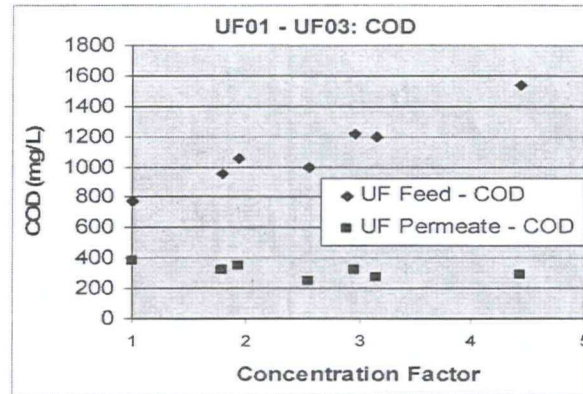


Figure 3.11a – UF01-UF03 feed and permeate COD results versus concentration factor

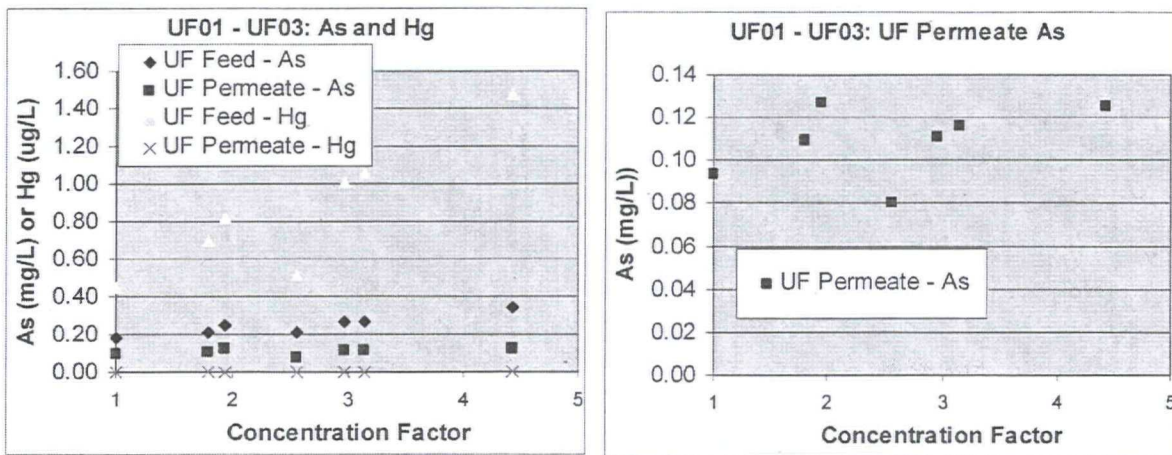


Figure 3.11b – UF01-UF03 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right). Permeate Hg was always non-detect at 0.1 ug/L MDL. Hg measured at 0.042 ug/L at a CF of 5.5 (data not shown).

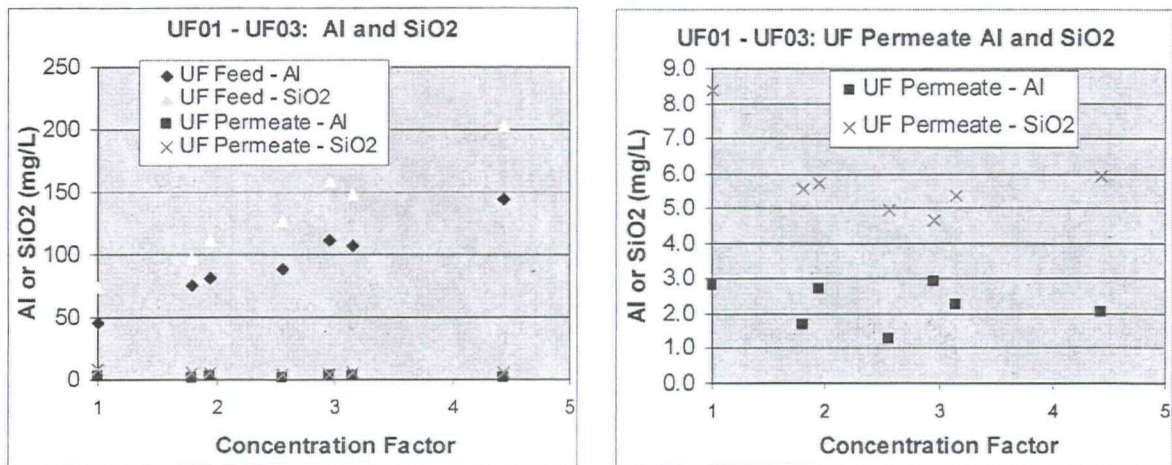


Figure 3.11c – UF01-UF03 Al and SiO2 feed and permeate results (left) and permeate results only on a smaller scale (right).

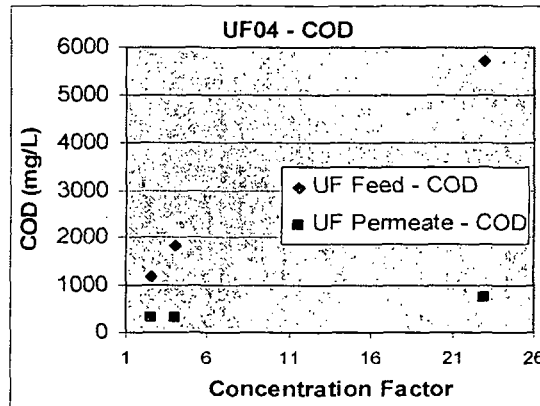


Figure 3.12a – UF04 UF feed and permeate COD results versus concentration factor.

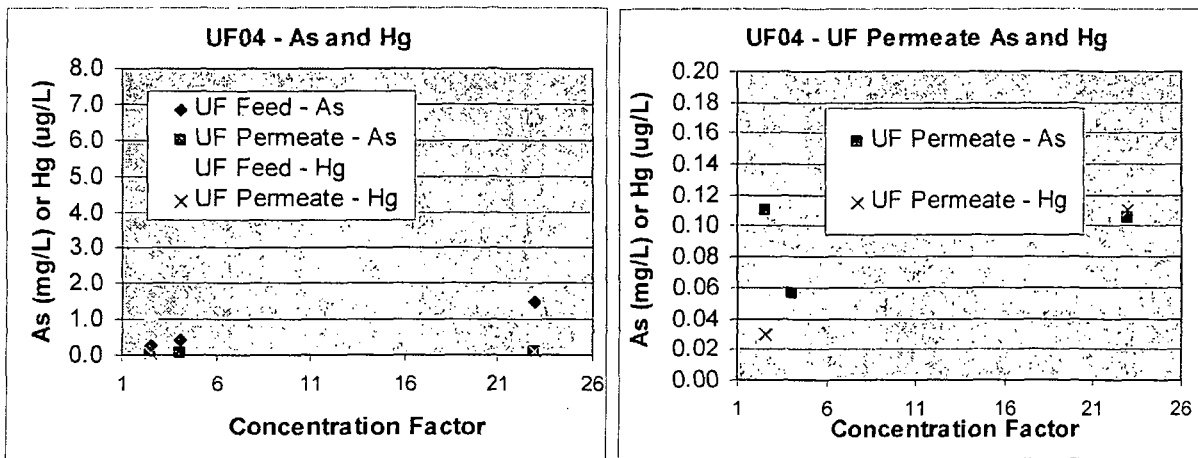


Figure 3.12b – UF04 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right).

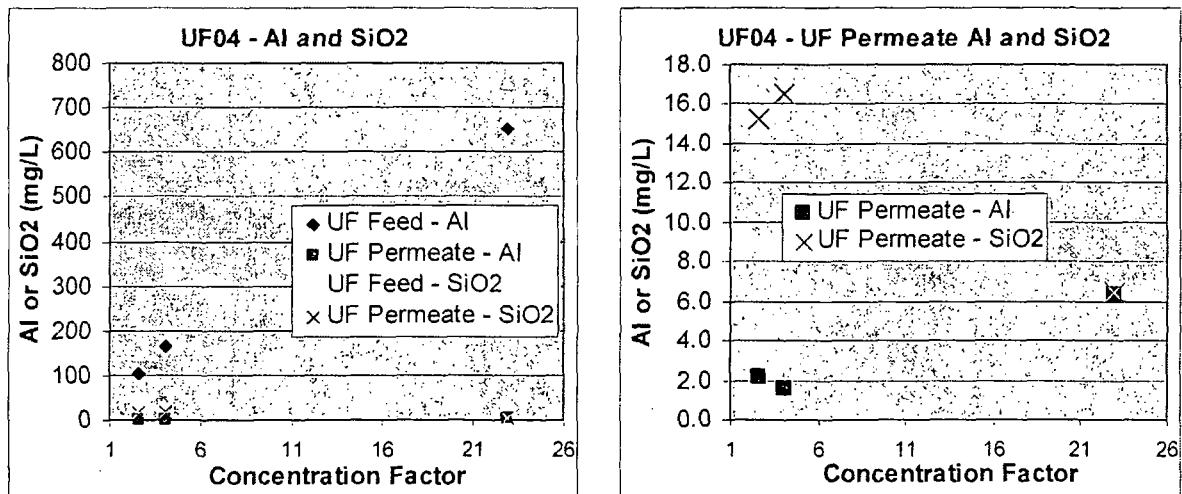


Figure 3.12c – UF04 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

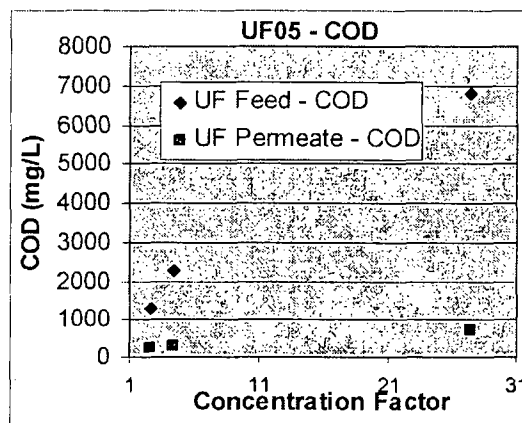


Figure 3.13a – UF05 UF feed and permeate COD results versus concentration factor.

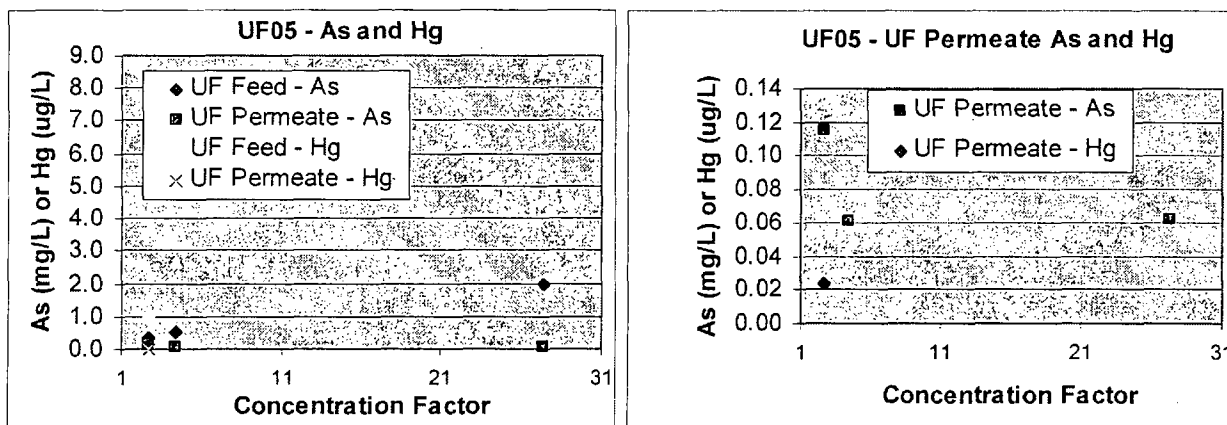


Figure 3.13b – UF05 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right). Hg results at CF 4 and 27 were non-detect at a 0.1 ug/L MDL.

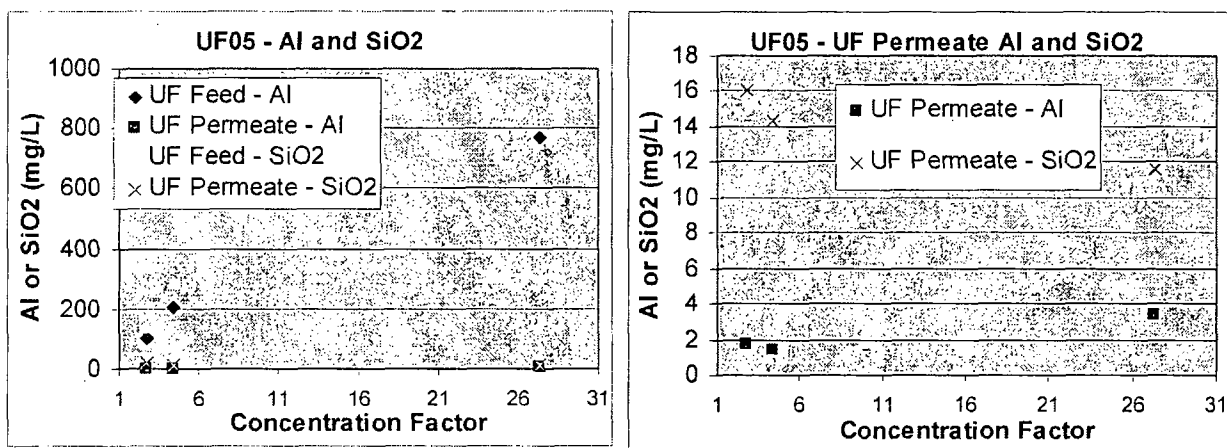


Figure 3.13c – UF05 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

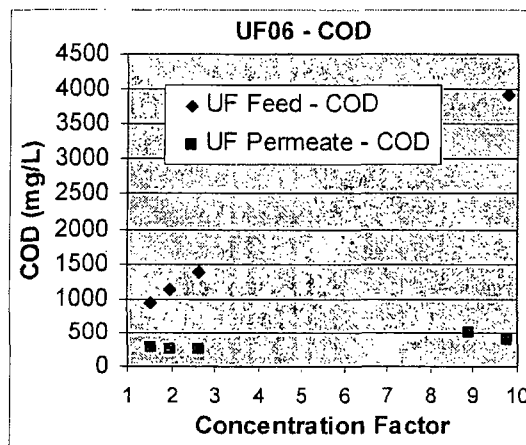


Figure 3.14a – UF06 UF feed and permeate COD results versus concentration factor.

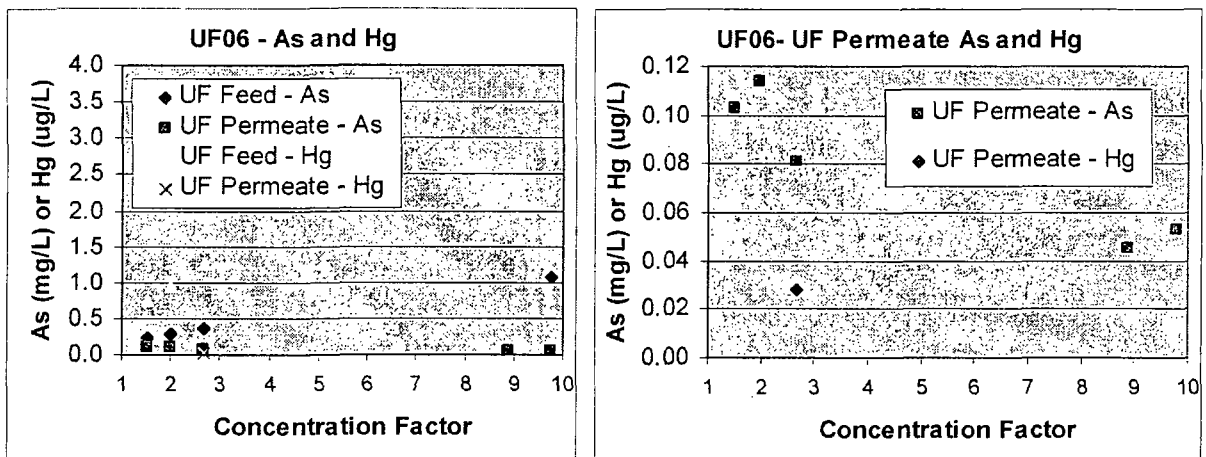


Figure 3.14b – UF06 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right). Hg results for other samples were non-detect at a 0.1 ug/L MDL.

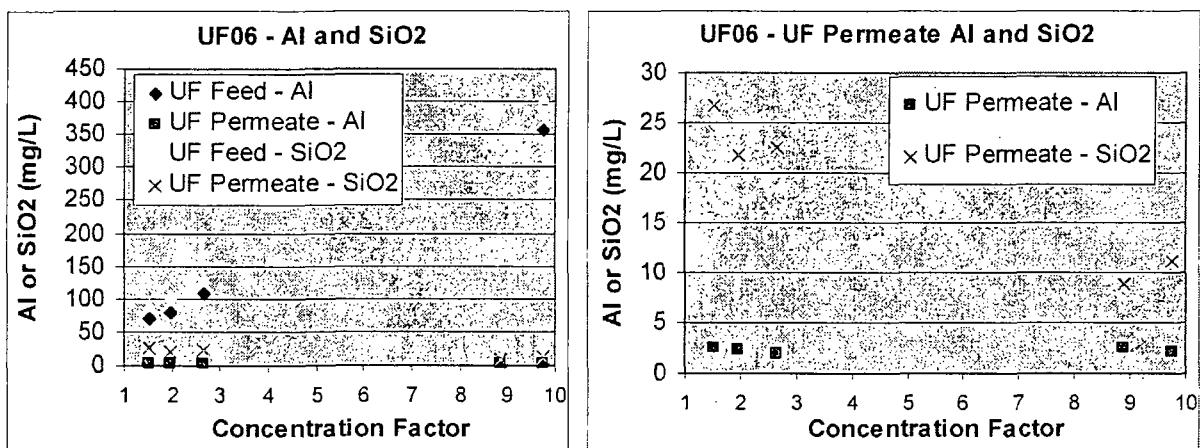


Figure 3.14c – UF06 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

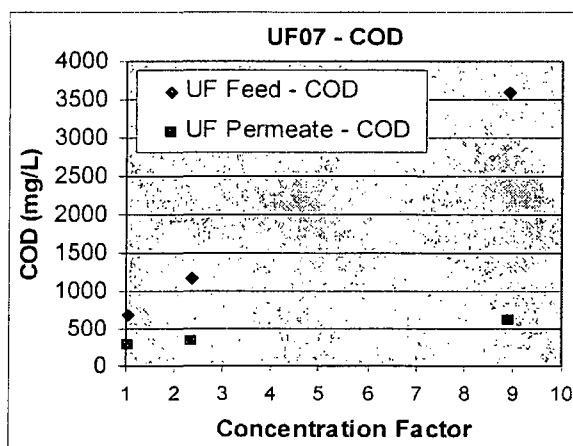


Figure 3.15a – UF07 UF feed and permeate COD results versus concentration factor.

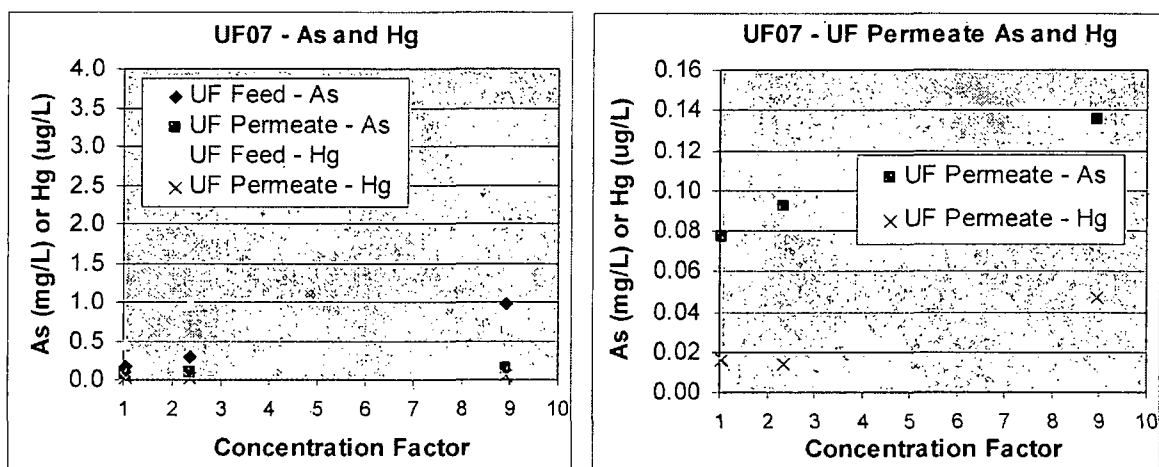


Figure 3.15b – UF07 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right).

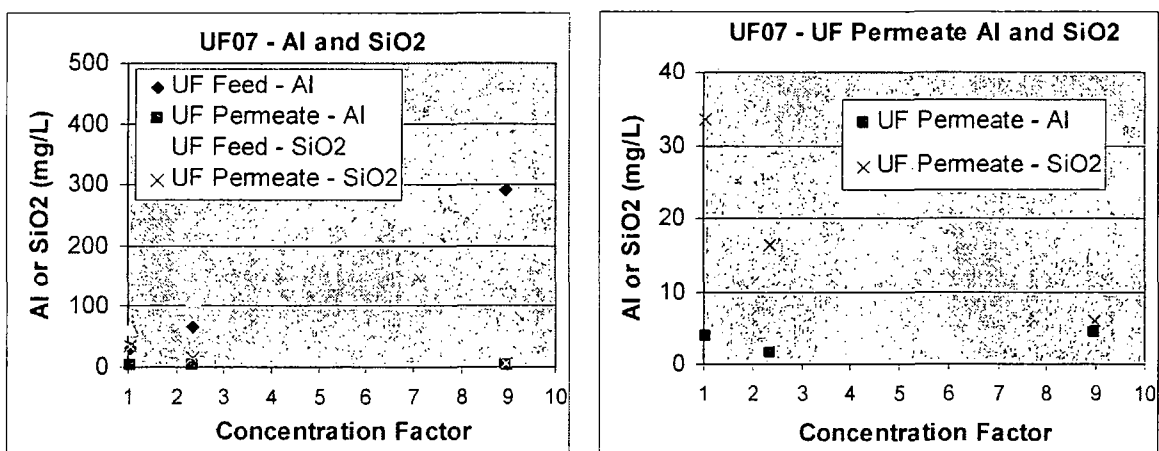


Figure 3.15c – UF07 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

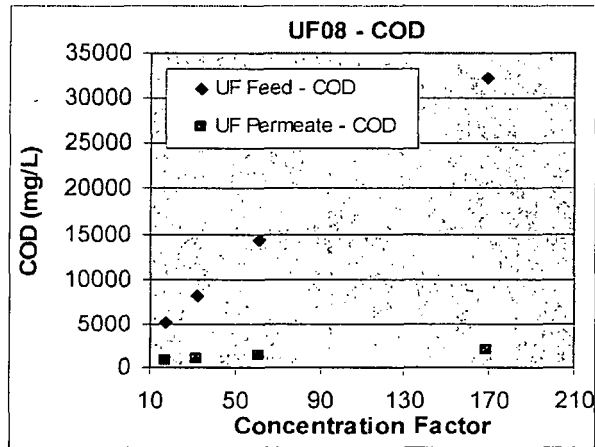


Figure 3.16a – UF08 UF feed and permeate COD results versus concentration factor.

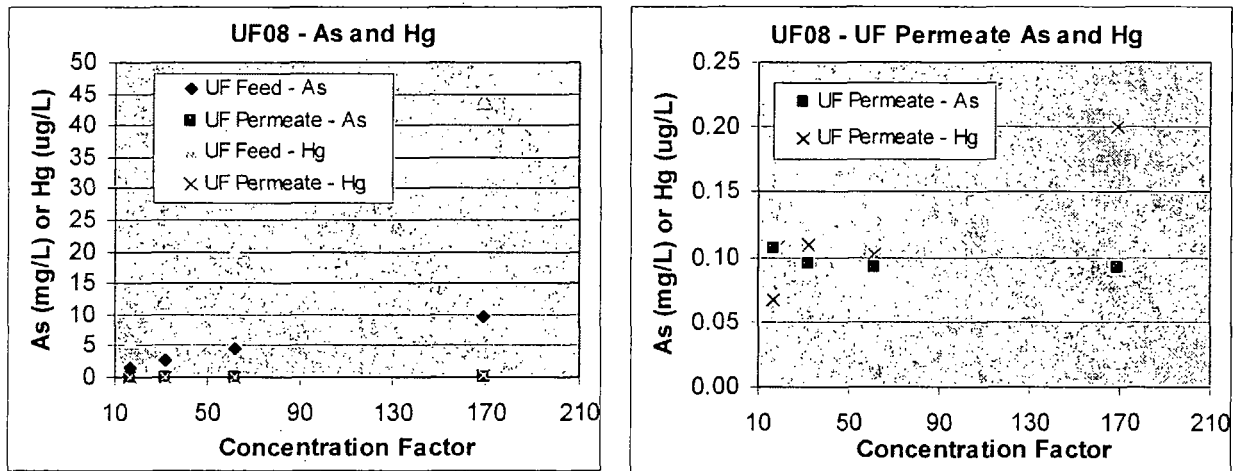


Figure 3.16b – UF08 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right).

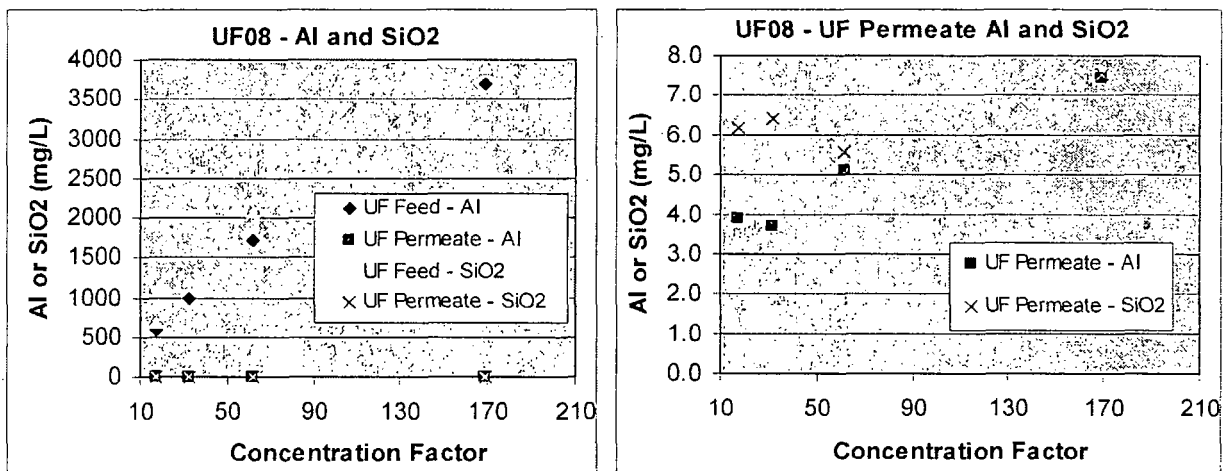


Figure 3.16c – UF08 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

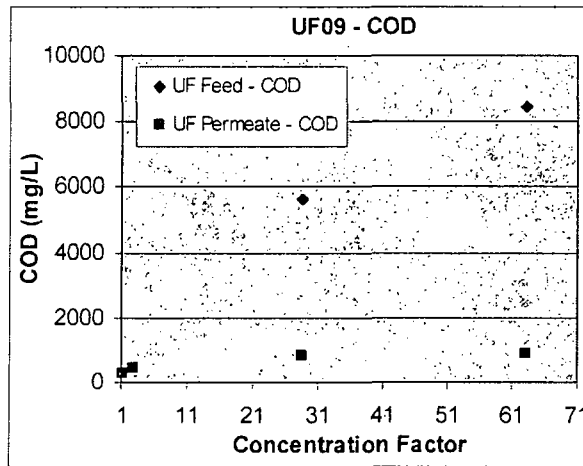


Figure 3.17a – UF09 UF feed and permeate COD results versus concentration factor.

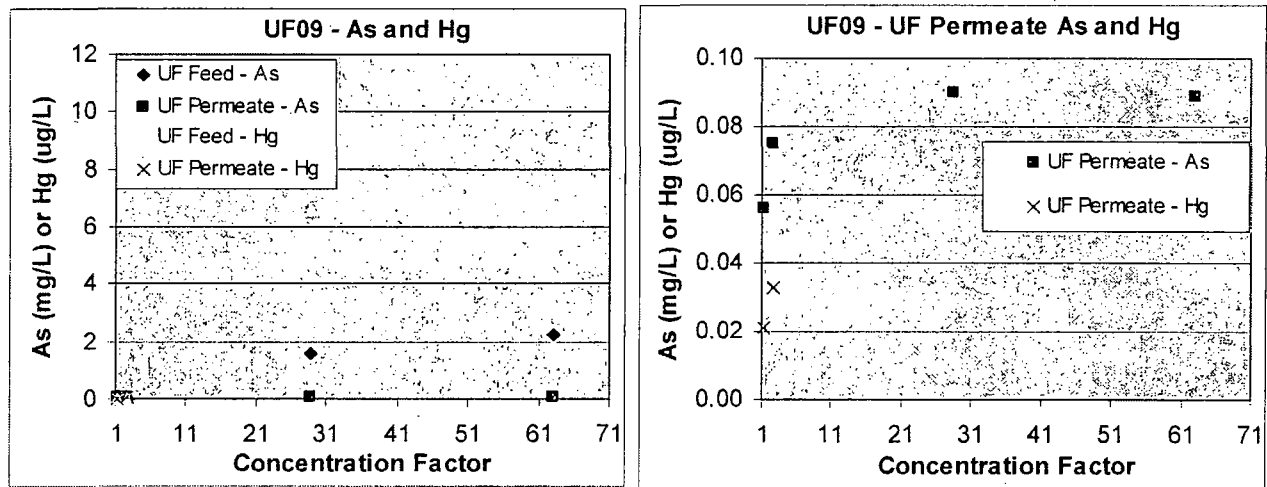


Figure 3.17b – UF09 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right). Hg results for samples collected at CF 29 and 63 were non-detect at 0.1 ug/L MDL.

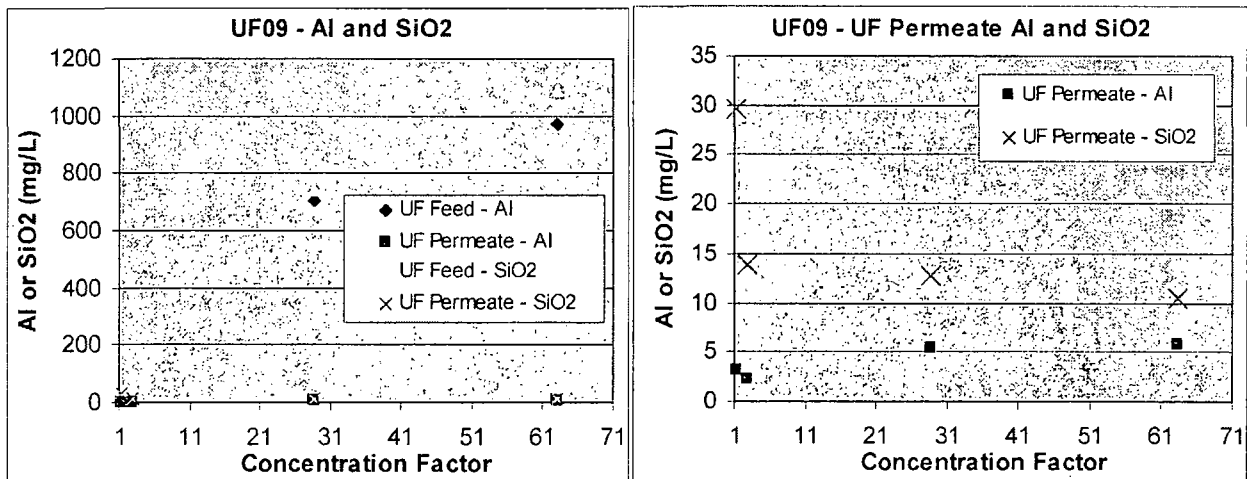


Figure 3.17c – UF09 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

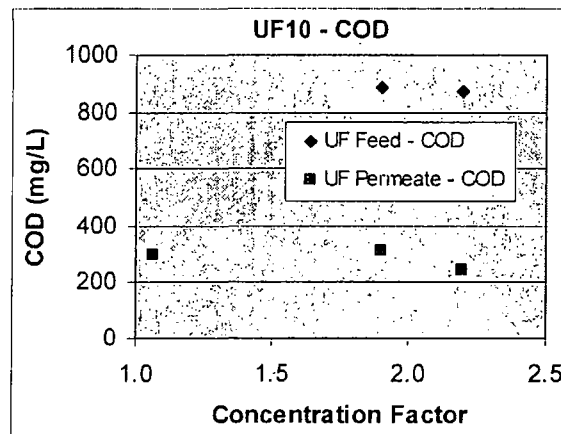


Figure 3.18a – UF10 UF feed and permeate COD results versus concentration factor.

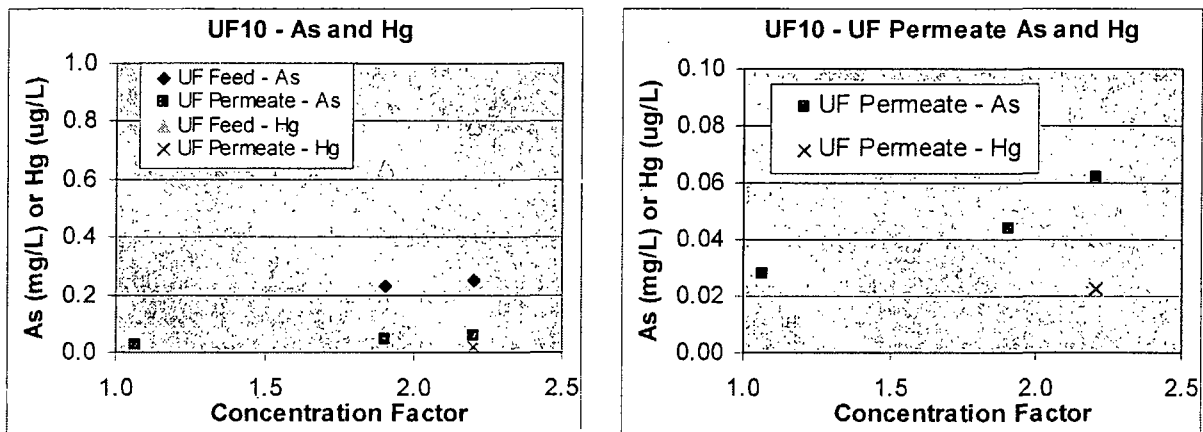


Figure 3.18b – UF10 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right). Hg results at CF 1.1 and 1.9 were non-detect at the 0.10 ug/L MDL.

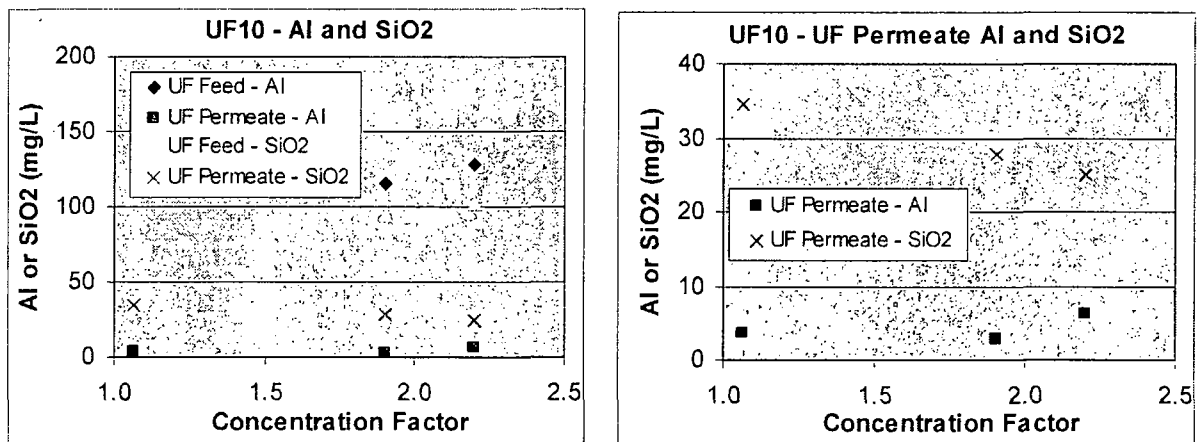


Figure 3.18c – UF10 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

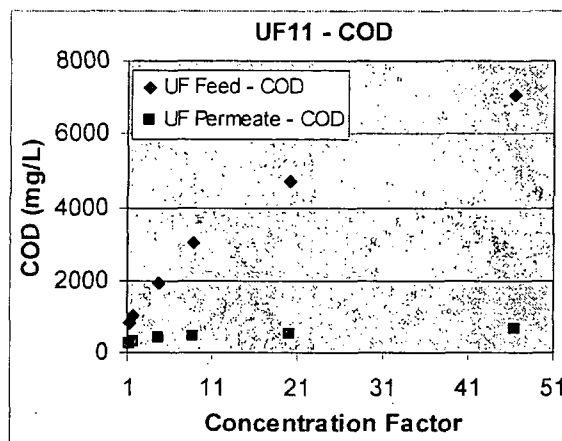


Figure 3.19a – UF11 UF feed and permeate COD results versus concentration factor.

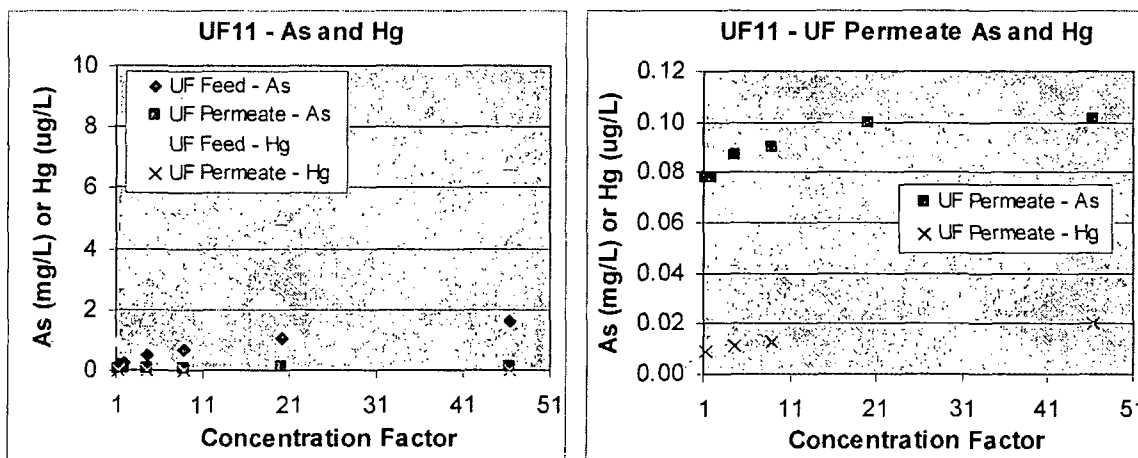


Figure 3.19b – UF11 feed and permeate As and Hg results (left) and permeate results only on a smaller scale (right).

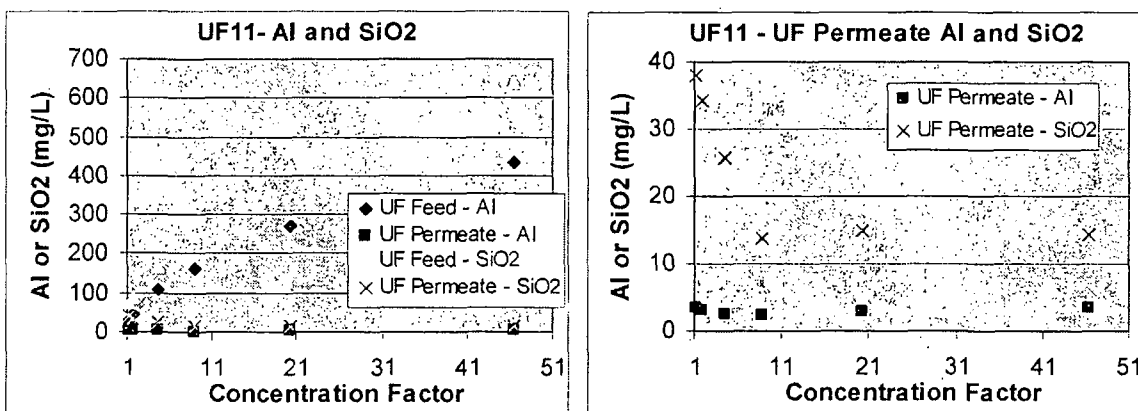


Figure 3.19c – UF11 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

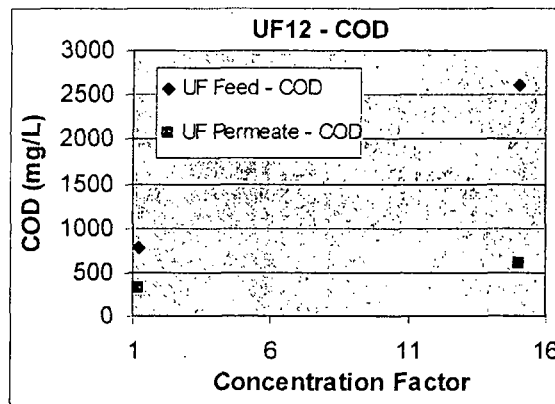


Figure 3.20a – UF12 UF feed and permeate COD results versus concentration factor.

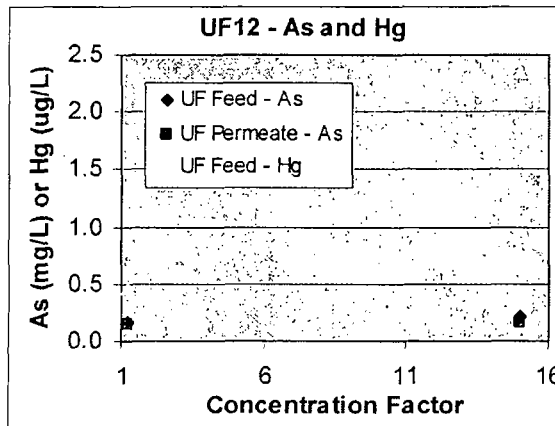


Figure 3.20b – UF12 feed and permeate As and Hg results. Hg permeate results were all non-detect at 0.1 ug/L MDL.

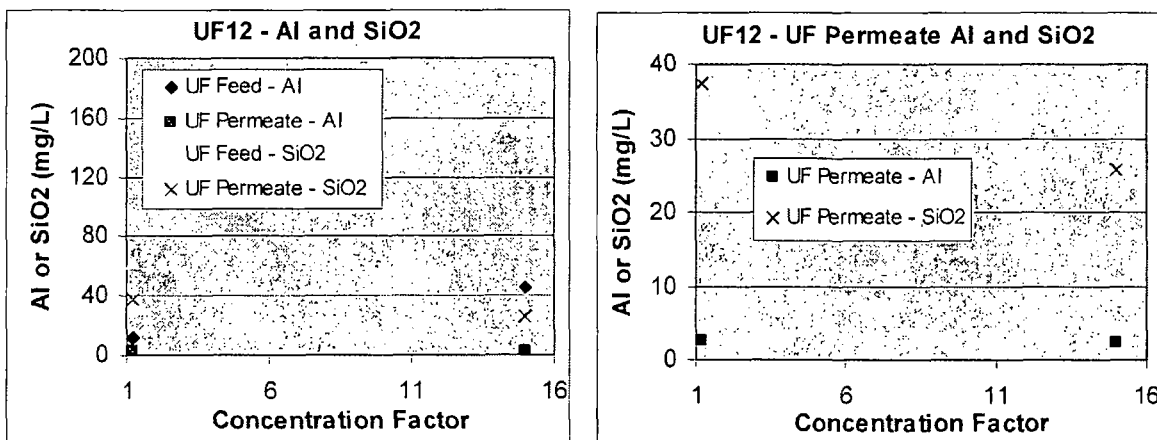


Figure 3.20c – UF12 feed and permeate Al and SiO2 results (left) and permeate results only on a smaller scale (right).

SECTION 4.0

INCLINED PLATE CLARIFIER TESTING

4.1 BACKGROUND

The use of gravity sedimentation to remove contaminants from water is an established, conventional water treatment process. The most critical part of a sedimentation process is to coagulate and flocculate solids that will separate by gravity within a reasonable amount of time. This was the challenging aspect of treating the Bay Harbor seep water. Bench scale batch tests demonstrated that a relatively high dose of alum and cationic polymer is required to form solids that can be removed by gravity separation. Given the amount of sludge produced, pilot testing was required to demonstrate that the system could function properly at full-scale and meet all of the discharge permit limits.

A pilot skid inclined plate clarifier with 33 ft² of settling area and an integral flocculation chamber was used to evaluate the sedimentation process. The goal of this test was to 1) demonstrate that a conventional sedimentation process could be used to consistently meet the pre-treatment limits, 2) develop design and performance data so an accurate comparative evaluation of the conventional and UF membrane treatment processes could be performed.

The basic procedure for the clarifier testing was to first adjust the pH of the neutralized seep water in the feed tanks to the target level. From the feed tanks, the seep water was pumped at a rate of approximately 2 gpm thru the two chemical mix reactors and into the inclined plate clarifier. Alum was continuously dosed to the first reactor to achieve a concentration of 6 mM as Al. A cationic polyelectrolyte (P-250HV, Chemco Inc.) was dosed to the second reactor at a dose of 100 ppm. The target pH after chemical addition was 7.5.

As the clarifier filled, the flocculation mixer was turned on and adjusted to a slow setting. The clarifier overflow was directed to the drain, while the sludge underflow was periodically pumped into the sludge tank, from where it was pumped to onsite storage tanks for offsite disposal. The clarifier test was conducted for 8 hours per day for three consecutive days. Grab samples of the clarifier overflow were collected every hour and composited at the end of each 8 hour test period to generate a representative sample. Sludge samples were also collected periodically and composited at the end of the three day test for Michigan 10 TCLP analysis.

4.2 RESULTS

The analytical results from the 3 day test are summarized in **Table 4.1**. A copy of the clarifier system data log is included in **Appendix A**, and a summary of the pilot test analytical results is included in **Appendix B**. Results demonstrate that a conventional coagulation / flocculation / sedimentation treatment process can be used to reduce COD, arsenic, mercury, and other metals. The average influent total suspended solids after alum and polymer addition was approximately 1,500 mg/L (based on bench-scale testing). The effluent suspended solids averaged 144 mg/L, giving a clarifier efficiency of approximately 90%.

The sludge underflow rate for the clarifier test was relatively high, averaging 20% of the total flow. The average 30-minute settled volume of the underflow sludge using a 2L graduated cylinder was 844 mL. Sludge dewatering was not evaluated during pilot testing,

although information regarding sludge conditioning requirements can be found in the previous bench scale testing report.

After the pilot clarifier was drained at the end of the three day clarifier test, the inclined plates were covered with a thin layer of brown, crystalline scale. A full-scale system that used an inclined plate clarifier would likely require regular cleaning to prevent scale accumulation from reducing treatment performance.

TABLE 4.1
RESULTS FROM CLARIFIER TESTING OF
BAY HARBOR SEEP WATER

Metal	Abbr.	Unit	Day 1	Day 2	Day 3	Average	Permit Limit
pH	pH	s.u.	7.59	7.84	7.91	7.78	6.5 – 9.5
Chemical O ₂ Demand	COD	mg/L	371	366	398	378	700
Total Suspended Solids	TSS	mg/L	95	143	194	144	300
Color	Color	color units	-	-	372	372	-
Aluminum	Al	mg/L	17.7	9.6	16.1	14.46	-
Arsenic	As	mg/L	0.035	0.030	0.037	0.034	0.20
Cadmium	Cd	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	0.022
Copper	Cu	mg/L	0.038	0.027	0.03	0.032	0.17
Lead	Pb	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	0.47
Mercury	Hg	µg/L	< 0.10	< 0.10	0.083	0.083	<0.2
Nickel	Ni	mg/L	0.085	0.087	0.094	0.089	1.20
Silica	SiO ₂	mg/L	11.0	8.6	10.8	10.1	-
Silver	Ag	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	0.091
Vanadium	V	mg/L	-	-	87	87	-
Zinc	Zn	mg/L	0.011	< 0.01	0.013	0.010	0.870

The sludge underflow was composited at the end of the 3 day clarifier testing for the Michigan 10 metals TCLP testing. The results are summarized in **Table 4.2** and confirm that the sludge generated by the treatment process would not be characteristically hazardous. This is consistent with the results from bench scale testing which showed that dewatered cake solids were also non-hazardous.

TABLE 4.2
MICHIGAN 10 TCLP RESULTS FOR CLARIFIER SLUDGE UNDERFLOW FROM
TESTING OF BAY HARBOR SEEP WATER

Metal	Abbr.	Unit	TCLP	Limit
Arsenic	As	mg/L	0.024	5.0
Barium	Ba	mg/L	<0.02	100
Cadmium	Cd	mg/L	< 0.005	1.0
Chromium	Cr	mg/L	< 0.02	5.0
Copper	Cu	mg/L	< 0.05	-
Lead	Pb	mg/L	< 0.01	5.0
Mercury	Hg	mg/L	< 0.001	0.2
Selenium	Se	mg/L	< 0.10	1.0
Silver	Ag	mg/L	< 0.005	5.0
Zinc	Zn	mg/L	< 0.10	-

4.3 SUMMARY

Pilot testing of the conventional coagulation / flocculation / sedimentation process using an inclined plate clarifier demonstrated that it could be used to remove a significant amount of the COD, arsenic, and mercury present in the Bay Harbor seep water. Due to the large amount of solids generated, the sludge handling and dewatering systems will be a critical component of the design and economic feasibility of the process. The key design parameters for the process are as follows:

- Reaction pH = 7.5
- Alum Dose = 6 mM as Al
- Cationic Polymer Dose (P250-HV) = 100 ppm
- Design Clarifier Loading Rate = 0.06 gpm / ft²
- Clarifier Influent Solids Concentration = 1,500 mg/L
- Sludge Underflow Rate = 25%
- Clarifier Solids Capture Efficiency = 90%

SECTION 5.0 CONCLUSIONS

5.1 CONCLUSIONS

Pilot testing of the Bay Harbor seep water demonstrated that an UF membrane filtration process or a conventional coagulation / flocculation / sedimentation treatment process can be used to meet the current permit limits for discharge to the City of Petoskey's POTW. The pilot testing fulfilled the requirements of the State of Michigan – City of Petoskey Administrative Consent Order No. 01-001-003.

While either of the pilot tested processes can meet existing permit limits for discharge to the City of Petoskey's POTW, the City of Petoskey has stated that it will no longer accept pretreated seep water from Bay Harbor.

Pilot testing demonstrated that pre-treatment via pH adjustment and a relatively small dose of alum (0.5 – 1.0 mM as Al) and Nalmet (10 – 50 ppm), followed by UF filtration up to a 10X concentration factor, could achieve effluent mercury concentrations in the range of 30 ng/L. The optimal pre-treatment conditions and design parameters for the UF membrane filtration process based upon pilot testing results are as follows:

- pH = 7.0 – 7.5
- Alum Dose = 1 mM as Al
- Nalmet Dose = 10 – 50 ppm
- Design Specific Flux = 0.87 gfd / psi
- UF Concentration Factor = 10X minimum
- Membrane Cleaning Requirements = acid cycle w/ mechanical cleaning every 24 – 48 hours w/ a final caustic + chlorine cleaning cycle (every 1 – 2 weeks).

The conventional coagulation / flocculation / sedimentation treatment process is capable of meeting the current permit requirements for discharge to the City of Petoskey's POTW, but is not able to achieve sufficient levels of mercury removal for direct discharge to Lake Michigan, and hence will not be a suitable treatment process for that option. Pilot testing of the conventional coagulation / flocculation / sedimentation treatment process using an inclined plate clarifier demonstrated that it could be used to remove a significant amount of COD, arsenic, and mercury present in the seep water. Due to the large amount of solids generated, the sludge handling and dewatering systems will be a critical component of the system's design and cost. The optimal pre-treatment conditions and design parameters for the conventional coagulation / flocculation / sedimentation treatment process based upon pilot testing results are as follows:

- Reaction pH = 7.5
- Alum Dose = 6 mM as Al

➤ Cationic Polymer Dose (P250-HV)	=	100 ppm
➤ Design Clarifier Loading Rate	=	0.06 gpm / ft ²
➤ Clarifier Influent Solids Concentration	=	1,500 mg/L
➤ Sludge Underflow Rate	=	25%
➤ Clarifier Solids Capture Efficiency	=	90%

5.2 PROPOSED TREATMENT SYSTEM DESCRIPTION

Given the possible future need to meet stringent mercury limits, the UF membrane filtration process is the recommended technology given its ability to achieve low mercury concentrations in the range of 30 ng/L. The UF membrane filtration process has additional engineering advantages due to its ease of operation, low footprint requirements, and expansion potential. The proposed treatment system P&ID is depicted in **Figure 5.1**. A brief description of the proposed treatment process is described below.

5.2.1 Influent Handling

The Bay Harbor seep water treatment facility will be designed to accept influent flow from four separate CKD leachate collection areas. In order to regulate flow into the seep water treatment facility, an influent hold tank and pumping system will be provided. The influent hold tank and pumping system will be sized to allow for a constant flow to the downstream process equipment.

5.2.2 pH Adjustment Via Acid Addition

The CKD leachate stored in the influent hold tank will be pumped at a constant flow rate through the treatment facility. An in-line sulfuric acid addition system will be used to adjust the seep water to from a pH of 12.5 to 7.5 – 8.0. The seep water pH must be adjusted to this range to obtain the optimal pH for alum coagulation and metals precipitation prior to ultrafiltration. A bulk storage tank will be required for storage of 98% concentrated sulfuric acid solution.

5.2.3 Coagulation/Precipitation

The pH adjusted seep water will flow into the first of two separate rapid mix tanks provided for the sequential addition of alum and Nalmet via automatic, flow-paced chemical feed systems. Alum and Nalmet addition is required to achieve sufficient reductions in heavy metals (particularly arsenic and mercury), dissolved silica, and naturally occurring organic matter (NOM). A bulk storage tank will be required for storage of 50% liquid alum solution. Nalmet will be delivered and stored in 55-gallon drums, and will be added to the rapid mix tank as 100% product or diluted in StrancoTM Polybend units or equivalent using the permeate obtained from the ultrafiltration process.

The acidity associated with the alum solution will also cause the pH of the seep water to drop slightly, requiring monitoring of the pH after chemical addition to ensure that the target pH is maintained.

5.2.4 Ultrafiltration

The treated seep water containing precipitated solids will be pumped to the UF feed tank, from where it will be circulated through the ultrafiltration tubular membranes. The permeate will be discharged to an effluent hold tank, while the concentrate will be sent to a concentrate hold tank. The ultrafiltration system will be skid mounted and come complete with circulation pumps (including one standby), a cleaning tank and mixer, membrane vessels, instrumentation and controls.

5.2.5 Effluent Handling

The ultrafiltration permeate will be stored in an effluent hold tank. The effluent hold tank will have sufficient capacity to retain the permeate produced over a 1-hour period minimum at normal design loadings. The effluent will be discharged to the designated receiving water and appropriate effluent monitoring will be carried out as defined by the NPDES permit requirements. The effluent transfer pumps will have a pumping capacity that will range from 50% to 150% of the average daily flow rate.

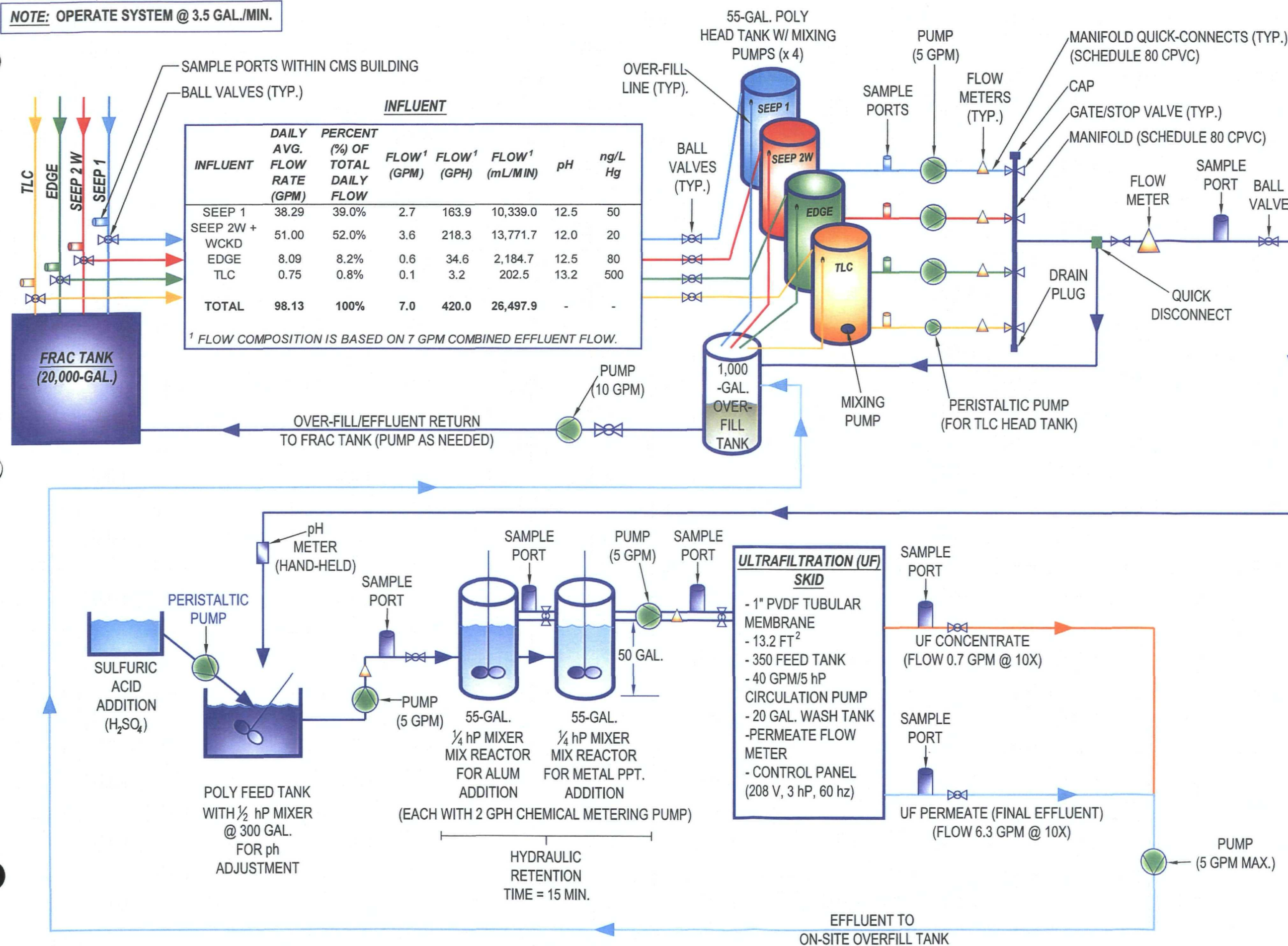
5.2.6 Concentrate Handling

The process outlined above will generate a concentrated liquid seep water residual requiring off-site disposal. The concentrated seep will be stored in a concentrate hold tank. Provisions will be made for the periodic transfer of concentrated seep from the hold tank into a tank truck for off-site disposal. The concentrated seep will be characteristically non-hazardous under RCRA regulations. The concentrate transfer pumps will be capable of transferring a 12,000 gallon tank truck load in 60 minutes or less.

FIGURE 2.1 PILOT SYSTEM P&ID

APPENDIX C

NOTE: OPERATE SYSTEM @ 3.5 GAL./MIN.



ECT
Environmental Consulting & Technology, Inc.
2200 COMMONWEALTH BLVD
SUITE 300
ANN ARBOR, MI 48105
TEL: 734-769-3004
FAX: 734-769-3164
www.ectinc.com

**BAY HARBOR
DEVELOPMENT**

CMS ENERGY

**EMMET COUNTY,
MICHIGAN**

REVISED 11-13-09
PRELIMINARY 10-27-09

070222
ECT PROJECT NUMBER

DESIGNED BY PFH CHECKED BY WES
DRAWN BY APPROVED BY

SHEET NAME

**PILOT
TREATMENT
SYSTEM**

NOT TO SCALE



FIGURE
1

**BAY HARBOR
DEVELOPMENT**



**EMMET COUNTY,
MICHIGAN**

REVISED 11-13-09
PRELIMINARY 10-23-09

070222
ECT PROJECT NUMBER

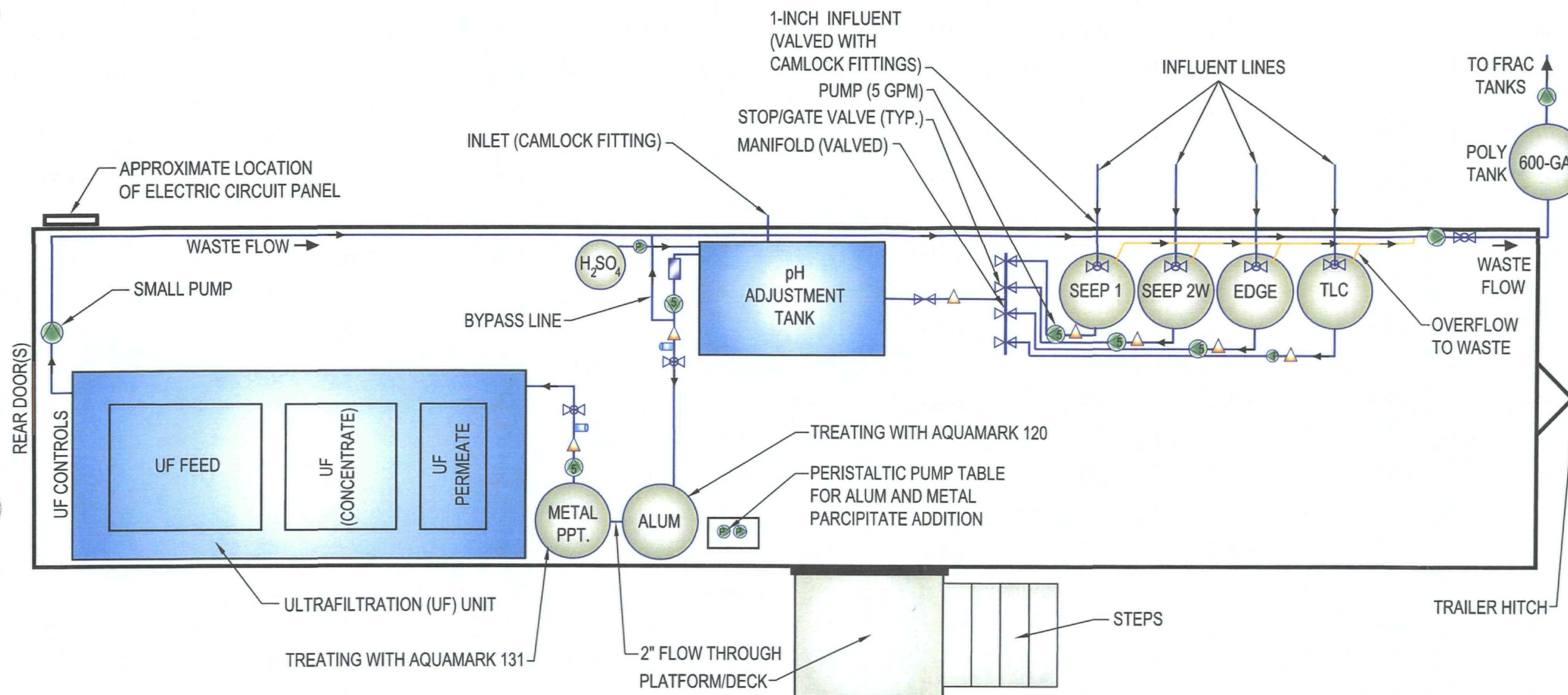
DESIGNED BY _____ CHECKED BY _____
PFH WES
DRAWN BY _____ APPROVED BY _____

SHEET NAME
**PILOT
TREATMENT
SYSTEM
FLOOR PLAN**

SCALE: 1" = 3' @ 11" x 17"



FIGURE
2



PLAN VIEW

NOTES

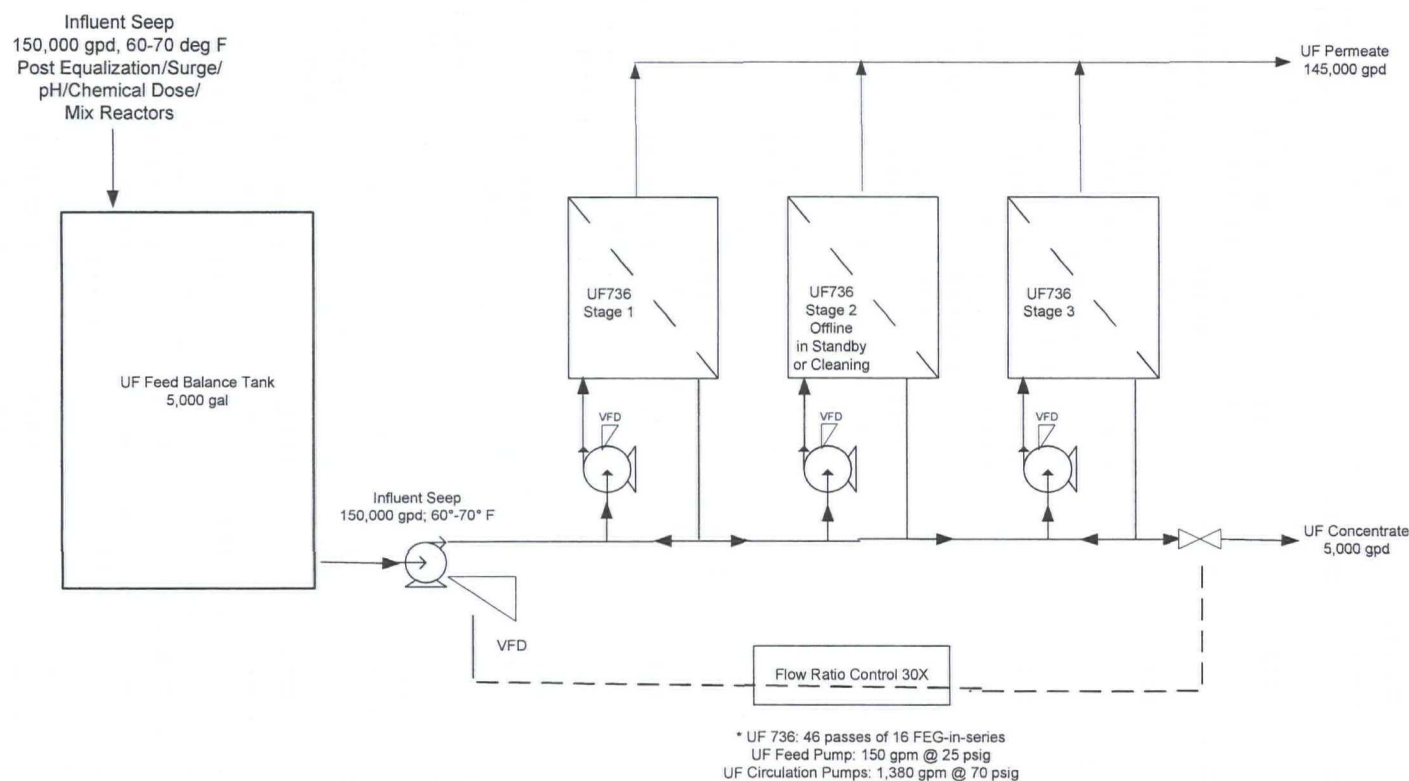
1. FLOOR PLAN SUBJECT TO CHANGE.
2. ALL FLOW METERS AFTER SPECIFIED PUMPS.

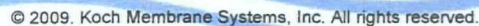
LEGEND

- BALL VALVE
- FLOW METER
- GATE/STOP VALVE
- PUMP (5 GALLON)
- PUMP (PERISTALTIC)
- pH METER
- SAMPLE PORT



CMS Energy Bay Harbor Development Michigan Leachate Seep Treatment Preliminary UF Process Flow Diagram – Continuous





FLOW SUMMARY (JANUARY 1ST, 2009 TO OCT. 8TH, 2009)

Seep 1					Seep 2					Edge Drain					Total Flow		WCKD		
Cumulative Flow	Average Daily Gallons (2009)	Weekly Average (2009)	Average Daily pH (2009)	Weekly Average pH (2009)	Cumulative Flow	Average Daily Gallons (2009)	Weekly Average (2009)	Average Daily pH (2009)	Weekly Average pH (2009)	Cumulative Flow	Average Daily Gallons (2009)	Weekly Average (2009)	Average Daily pH (2009)	Weekly Average pH (2009)	Average Daily Gallons (2009)	Weekly Average (2009)	Cumulative Flow	Average Daily Gallons (2009)	Weekly Average (2009)
	55,137	54,654	12.0	12.0		53,833	53,492	9.5	9.5		11,651	11,716	12.7	12.7	120,620	119,862		19,610	19,444

	Average Daily Gallons (2009)	Average Daily Flow (gpm) (2009)	Weekly Average (2009)	Percent (%) of Total Daily Flow
Seep 1	55,137	38	54,654	39%
Seep 2 + WCKD	73,443	51	72,936	52%
Edge Drain	11,651	8	11,716	8%
TOTAL	140,230	97	139,306	100%

	Average Daily Gallons (2009)	Average Daily Flow (gpm) (2009)	Average Daily Flow (gph) (2009)	Average Daily Flow (mL/min) (2009)	Percent (%) of Total Daily Flow
Seep 1	55,137	38.29	2,297.4	144,941.8	39.0%
Seep 2 + WCKD	73,443	51.00	3,060.1	193,063.7	52.0%
Edge Drain	11,651	8.09	485.4	30,626.5	8.2%
TLC*	1,080	0.75	45.0	2,839.1	0.8%
TOTAL	141,310	98.13	5,887.94	371,471.03	100%

* TLC pumps on average at 15 minutes/hour and 3 gal/min. = 1,080 gal/day.

INFLUENT COMPOSITION @ 7 GPM COMBINED EFFLUENT FLOW

COMBINED EFFLUENT FLOW (GPM) = 7.0

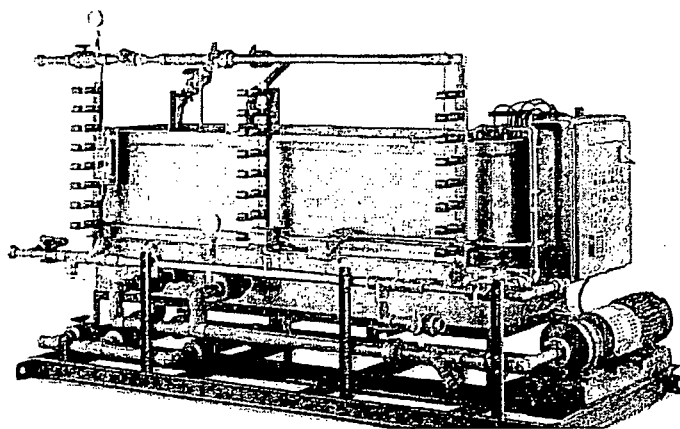
	PERCENT (%) OF TOTAL DAILY FLOW	FLOW (gpm)	FLOW (gph)	FLOW (mL/min)
Seep 1	39.0%	2.7	163.9	10,339.0
Seep 2 + WCKD	52.0%	3.6	218.3	13,771.7
Edge Drain	8.2%	0.6	34.6	2,184.7
TLC	0.8%	0.1	3.2	202.5
TOTAL	100.0%	7.0	420.0	26,497.9

APPENDIX D

Tubular Ultrafiltration Pilot Model UF 1x16

The Koch Membrane Systems' (KMS) Tubular Ultrafiltration Pilot, Model UF 1x16, is designed for field testing FEG™ Plus and UTRA-COR® tubular ultrafiltration modules. It can be used with optional equipment to test SPIRAPAK™ spiral ultrafiltration elements, as well. The UF 1x16 is entirely skid mounted and designed to be compact and readily installed in the field with limited site preparation. The unit is designed for an indoor, general purpose industrial environment. The services of a KMS Process Technology Engineer or Technician are required for start-up assistance and operator training. The pilot unit consists of the following major components:

- Painted, carbon steel equipment skid.
- Multi-compartment tank with process, cleaning and permeate sections; process section with level controls; nominal volume 320 gal.
- Circulation pump with a 10 HP, 230/460 VAC, 60 cycle, 3500 RPM motor.
- Unit piping and manual valves (PVC) including spongeball insertion port and spongeball retrieval basket.
- One (1) control panel with motor starter, operator switches and local alarms.
- Inlet Y-strainer.
- Inlet and outlet pressure gauges.
- Inlet low pressure switch.
- Temperature gauge.
- Inlet high temperature switch.
- Permeate flow meter.
- Up to sixteen (16) tubular membrane modules.¹
- One gallon KOCHKLEEN® membrane cleaner.¹
- Operable with either 230/3/60 or 440/3/60 power.
- Approximate dimensions of skid 12'-9" long x 5'-0" wide x 6'-6" high.
- Approximate weight 2,500 lbs.



KMS UF1x16 Tubular Ultrafiltration Pilot

¹ Selection of membranes and cleaning chemicals is application specific.



ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.

LEACHATE TREATMENT

UF 1 x 16 PILOT TESTING

**USING KMS TUBULAR UF ABCOR[®] FEG[™] Plus 1" HFP-276 ,
1" HFM-251, and Multi-tube ABCOR[®] ULTRA-COR[®] HFM-251
MEMBRANES**

PILOT PROTOCOL

Prepared for

ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.

Test Site: Bay Harbor Resort; Petoskey, MI

Planned Start Date: November 2, 2009

Prepared by: Andrew Marcinkowski, Koch Membrane Systems

CONFIDENTIALITY NOTICE

This document contains confidential and proprietary information owned by Koch Membrane Systems. We grant you permission to retain the document in your files and to have access to the information contained herein based on the understanding that you will not knowingly make the document or its contents available to persons outside your company or employment.

© 2009, Koch Membrane Systems, Inc. All rights reserved

TABLE OF CONTENTS

Introduction	3
Technical Targets	3
Equipment and Membranes to be used	4
Test Protocol	6
Sampling and Analytical Requirements	9
Log sheets for data collection	10
Final Report	10

List of Appendices

Appendix A: Pilot Outline, Flow, and Electrical Drawings	11
Appendix B: Membrane Spec Sheets.....	17
Appendix C: Cleaning Water Quality Guidelines	24
Appendix D: Clean Water Flux Calculations	26
Appendix E: Cleaning Chemical Spec Sheets and MSDS.....	30
Appendix F: Process and Cleaning Logs	57

PILOT PROTOCOL OUTLINE

Introduction

CMS Energy has contracted Environmental Consulting & Technology, Inc. (ECT) to conduct a pilot study at their Bay Harbor resort development on the leachate of cement kiln dust (CKD). The resort development was built around and on an old cement manufacturing site. The leachate from the site has a pH greater than 12, contains high levels of suspended solids, and heavy metals, including arsenic and mercury. ECT approached KMS about the use of ultrafiltration membrane technology to polish pre-treated leachate. The pre-treatment will consist of pH adjustment using hydrochloric acid followed by a coagulation-flocculation-sedimentation process using aluminum sulfate (alum) with a cationic polymer flocculant aid. Previous pilot studies have shown the pre-treatment/UF treatment will work, but permit restrictions to the POTW have caused CMS to look for another alternative. The owner's of Bay Harbor (CMS) want to send the effluent to Lake Michigan, but a new pilot study must be conducted to satisfy NPDES requirements.

The Bay Harbor site is expected to treat 150,000 gpd of leachate. The pilot objectives are:

1. Gather operational data to confirm expected design parameters.
2. Evaluate TSS and heavy metal reduction during the pilot tests.
3. ECT to evaluate permeate quality for discharge to Lake Michigan.
4. Collect samples from the pilot, including feed, concentrate, and permeate from each membrane type for analysis to confirm expected commercial design.

The UF pilot to be used is a 1 x 16 tubular unit.

Technical Targets

Objectives of the pilot are:

1. To produce UF permeate with less than 10 mg/L TSS.
2. To reduce all heavy metals below their NPDES permitted levels.
3. To determine the sizing and configuration for design of a UF membrane system. Expecting to operate up to at least 10X or 90% permeate volume recovery or initial feed volume reduction.
4. To determine membrane type most effective in treating water.
5. To determine UF membrane cleaning protocol.
6. To analyze feed constituents.

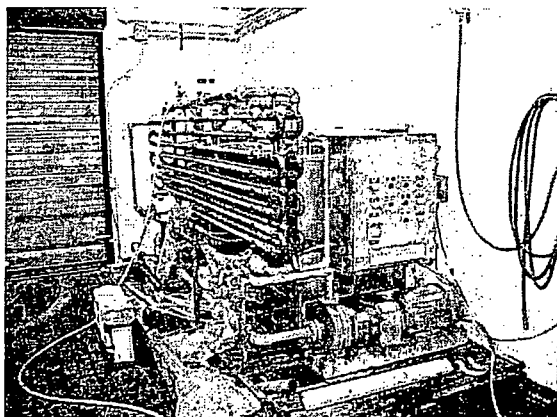
Equipment and Membranes to be used

The pilot uses a 16 tubes-in-series configuration and is shown in Figure 1. The UF Pilot will consist of the following major components:

- One (1) painted, carbon steel equipment skid.
- One (1) 320 nominal gallon, multicompartment tank with Process, Cleaning and Permeate sections. Process section will have level controls.
- One (1) process circulation pump with a 10 HP, 230/460 VAC, 60 cycle, 3500 RPM motor.
- One (1) inlet Y-strainer.
- Two (1) pressure gauges.
- One (1) inlet low pressure switch.
- One (1) temperature gauge.
- One (1) inlet high temperature switch.
- Circulation line flow meter.
- Permeate flow meter.
- Sixteen (16) 1" diameter x 10' long, tubular, UF membranes. Exact membrane selection will depend on the particular application in question.
- Five-gallon pails of KOCHKLEEN® membrane cleaner.
- Unit piping and manual valves (PVC) including spongeball insertion port and spongeball retrieval basket.
- One (1) control panel with motor starter, operator switches and local alarms.
- Approximate dimensions of the equipment skid and process/cleaning tank will be 12' – 9" Long x 5' – 0" Wide x 6' – 6" High.

Purchaser to provide all utilities (including 480V 3 phase 60 cycle electrical supply, 30 amp; Minimal city water quality for cleaning and flushing; feed and permeate tanks, installation labor and materials, including enclosure; Consumables, safety equipment, etc.

System should be placed at the first test site and supplied electrically before arrival of a KMS process engineer. A feed pump or gravity feed system to supply at minimum 5 gpm to system should be set up prior to arrival of KMS process engineer. Installation of membranes and set up of piping will be done upon arrival of the engineer. A start-up hydraulic test with city water will need to be conducted on the system to ensure integrity after shipment. Standard operating procedures for both process and cleaning will be written during the week of training. The operators will review and the procedures will be edited as required.

Figure 1: UF 1 x 16 Pilot

Pilot outline, flow and electric drawings can be found in Appendix A.

UF FEG™ tubular membranes are selected for this pilot study due to their ability to handle relatively high TSS in the raw wastewater stream, especially towards the end of a process run where solids are concentrated. Two different types of UF membranes, HFP-276 and HFM-251, are selected for this study to run side by side to show the effect of membrane chemistry and charge on performance. Tests will be conducted with sixteen tubes in series. The pilot setup will be with like membrane types bundled on the permeate side by groups of four. Membranes will be positioned in the pass of 16-in-series to have the same average transmembrane pressure (TMP) and circulation flow, enabling true membrane performance comparison between the two membrane types.

The HFP-276 UF membrane is negatively charged, while the HFM-251 UF membrane is non-charged. The pore sizes of the HFP-276 and HFM-251 membranes are 120,000 and 100,000 MWCO, respectively.

UF ULTRA-COR® tubular membranes will also be evaluated to determine if the ½" multi-tube configuration would be more effective than the 1" tube configuration. HFM-251 membrane chemistry is used in the multi-tube configuration.

Membrane Spec Sheets can be found in Appendix B.

Test Protocol

Pilot tests are to be conducted at Bay Harbor's treatment site for one month of operation. An additional month of piloting may be required if ECT needs additional sampling.

The test will start using the following configuration and operating parameters:

- 16 tubes-in-series with like membrane bundled in groups of 4 at the same average pressure.
- Operating pressures of 84 psi inlet and 20 psi outlet with a 4 psi pressure drop per tube.
- Circulation flow of 30 gpm.

The test schedule will be as follows:

Prior to KMS engineer arrival:

- Electrical connections set up and pump checked for rotation. (Pump rotation check requires holding reset button and hitting the start button. Both buttons are on the front of pilot control panel.)
- Installation of feed delivery system and piping to pilot. (Note: The pilot is equipped with 110V service that is controlled by the pilot process tank level switches that can be used for a feed pump, solenoid valve, or an air actuated valve for a diaphragm pump to send feed to the pilot. The feed system must deliver at least 5 gpm.)
- Adequate cleaning water supply available for pilot. Each cleaning will require approximately 200 gallons of city water. (Note: Appendix C contains the cleaning water quality guidelines.)
- Adequate supply of sample bottles available at site and lab set up for testing. (See Sampling and Analytical Requirements Below for additional details.)

Day 1

- KMS engineer arrives at site.
- Installation of membrane and piping set up by KMS engineer. (2 to 3 hours)
- Pre-cleaning of membranes. Initial clean water flux determined. (1 to 2 hours) (Note: Appendix D contains the calculations for clean water flux and the temperature correction table.)
- Initial training for ECT personnel on cleaning chemical MSDS, pilot piping, control panel, and operating procedures, including analytical sampling. (1 hour)

Day 2

- Conduct Flux Stability Test at 1X (Test 1) to evaluate feed stream fouling characteristics on the membranes. (4 hours) (See General Experimental Guidelines for additional detail on test operation.)
- Conduct Batch Test (Test 2) to generate a quick baseline for flux versus concentration. (6 hours)

- Test 2 Feed/Concentrate and Membrane Permeate Samples will be collected at the following concentration factors during this test, 1X, 2X, 5X, 10X, and Final X.
- Start Cleaning by conducting once-thru flush and detergent cleaning. (1.5 hours)
- Train ECT personnel on data collection for operation and cleaning log, operating and cleaning procedures, analytical sampling, and cleaning procedures.
- Write operating procedures for pilot operation.

Day 3

- Complete Cleaning (Acid Step) if clean water flux is inadequate after detergent cleaning. (1.5 hours)
- Conduct Modified Batch Test (Test 3) to produce flux versus concentration curves to evaluate pilot system performance over time and concentration range. (24 hours to 30 hours – will carry into Day 4).
- Test 3 Feed/Concentrate and Membrane Permeate Samples will be collected at the following concentration factors during this test, 1X, 5X and Final X.
- During Test 3, 3 sets of flow and pressure excursion data will be taken at 1X, 5X, and Near Final X concentration factors. (Each set of tests takes approximately 1.5 to 2 hours).
 - Pressure excursion data will be taken by collected flow data from the 16 individual tubes.
 - Flow excursion data will be taken by collecting flow data from the 16 individual tubes after the cross flow or DP per tube has been changed. Flow excursions will be conducted at DP/tube of 4, 5, 3, and 4 psi.
- ECT personnel to review pilot operating procedures.

Day 4

- Complete Test 3. (Assuming around mid-day)
- Train ECT personnel on conducting a cleaning on pilot system. (2 to 4 hours) (Note: Appendix E contains the cleaning chemical MSDS sheets.)
- ECT personnel to further review and edit pilot operating and cleaning procedures.
- Start Modified Batch Test (Test 4) to check reproducibility of data after cleaning. (Approximately 18 hours)
- Test 4 Feed/Concentrate and Membrane Permeate Samples will be collected at the following concentration factors during this test, 1X and Final X.

Day 5

- Complete Test 4. (Assuming early morning)
- ECT personnel to conduct cleaning. (2 to 4 hours)
- KMS engineer returns home.

Additional Tests:

- KMS engineer and ECT personnel will review initial test site data and determine:
 - Pressures and flows to operate at.
 - Cleaning steps to use for adequate cleaning.
- ECT personnel conduct the following:
 - Collect operational data in modified batch mode.
 - Collect cleaning data.
 - Collect feed/concentrate and permeate samples at 1X and final X for each test conducted.
 - Fax or email data to KMS engineer preferably on a daily basis and at least at a minimum of twice per week so that the data can be analyzed in a timely manner.

Sampling and Analytical Requirements

Sampling schedule for the first five day and subsequent visits to additional sites are noted above and should include the following:

	Feed	Concentrate	Permeate
Heavy Metals	TBD	TBD	TBD
Total Solids	E/I	E/I	E/I
Suspended Solids	E	E	E
PH	E	E	E
Conductivity	E	E	E
Total Oil & Grease	E/I	E/I	E/I
True Petroleum Hydrocarbons	E/I	E/I	E/I
Viscosity (if required)	E	E	
BOD/COD (if required)	E	E	E/I

Key:

E = 1X and final "X" each test

I = First three tests at X (2X, 5X, 10X, 20X and as appropriate) factors other than 1X and final X to develop concentration profile. Intermittently thereafter.

Additionally one set of feed and permeate samples will need to be analyzed at each site for:

Calcium _____ Magnesium _____ Sodium _____
 Barium _____ Potassium _____ Manganese _____
 Total Iron _____ Portion as Fe++ _____ Portion as Fe+++ _____
 Aluminum _____ Carbonate _____ Bicarbonate _____
 Sulfate _____ Chloride _____ Fluoride _____
 Silica (SiO₂) Total _____ Total alkalinity _____ Total hardness _____
 Solvents _____

Note: Analytical labs have a comprehensive test that will measure all the above components, along with approximately 60 organic solvents.

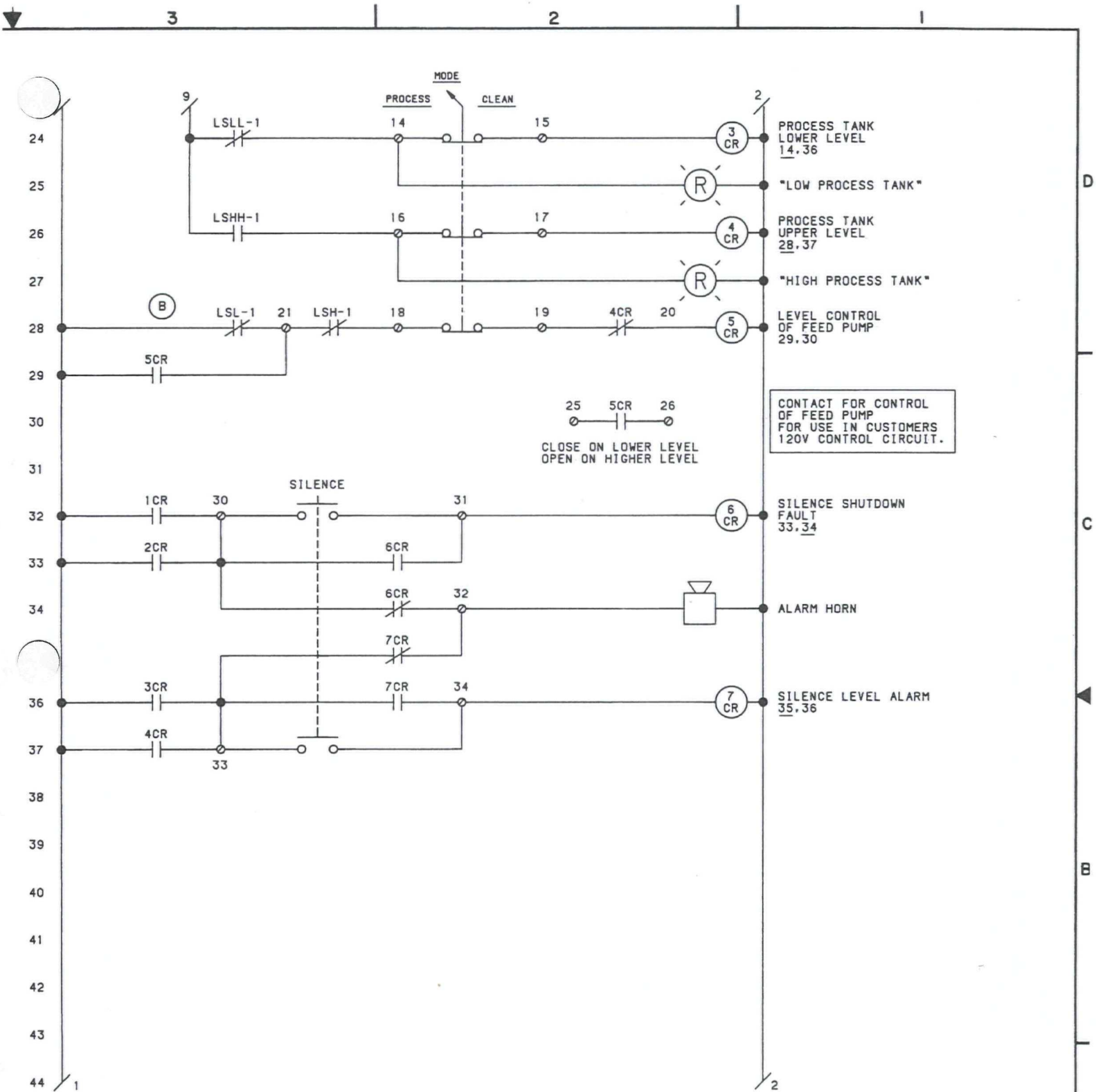
Log sheets for data collection

The log sheets for operational data and cleaning can be found in Appendix F. Operational data will be collected every half hour for the first four hours of operation and every two hours thereafter. With overnight operation, data can be taken at 8 to 12 hour intervals.

Final Report

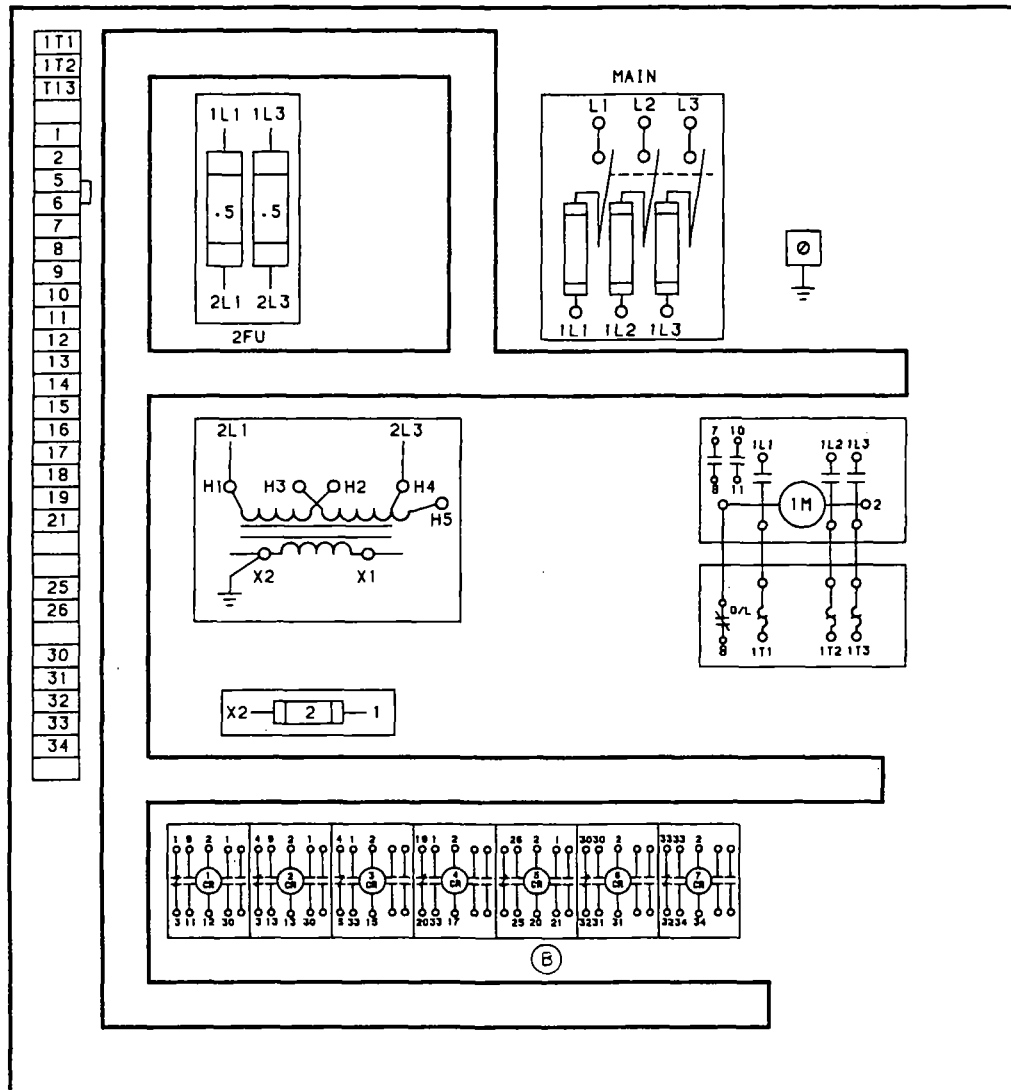
At the conclusion of the pilot study, a detailed report will be issued summarizing all the data collected during the pilot test.

Appendix A: Pilot Outline, Flow, and Electrical Drawings



SEPARATE PARTS LIST YES <input type="checkbox"/> NO <input type="checkbox"/>		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: ANGLES, ± FRACTIONS, ± DECIMALS, .XX± XXX±		NAME DATE		KOCH KOCH MEMBRANE SYSTEMS INC 850 Main Street Wilmington, Ma. 01887	
APPLICATION USED ON		MATERIAL:		DRAWN R. J.		9.23.88	
		FINISH:		CHECKED <i>AC</i>			
				ENGINEER <i>AC</i>			
				PROJ APP			
				MICROFILM			
				PROJ NO.			
				MADE FROM			
				SCALE		SHEET 1 OF 3	
				KMS PART NO.		SIZE D	
				TITLE UF 1 X 16 PILOT SYSTEM ELECTRICAL SCHEMATIC		REV. C	
				6733-6001			



AI
ES
-1
AN/CIRC
PUMP
-13
TSH-1
-10
PSL-1
H-1 16
I-1 18
-1 1
L-1 14
TANK
TCHES

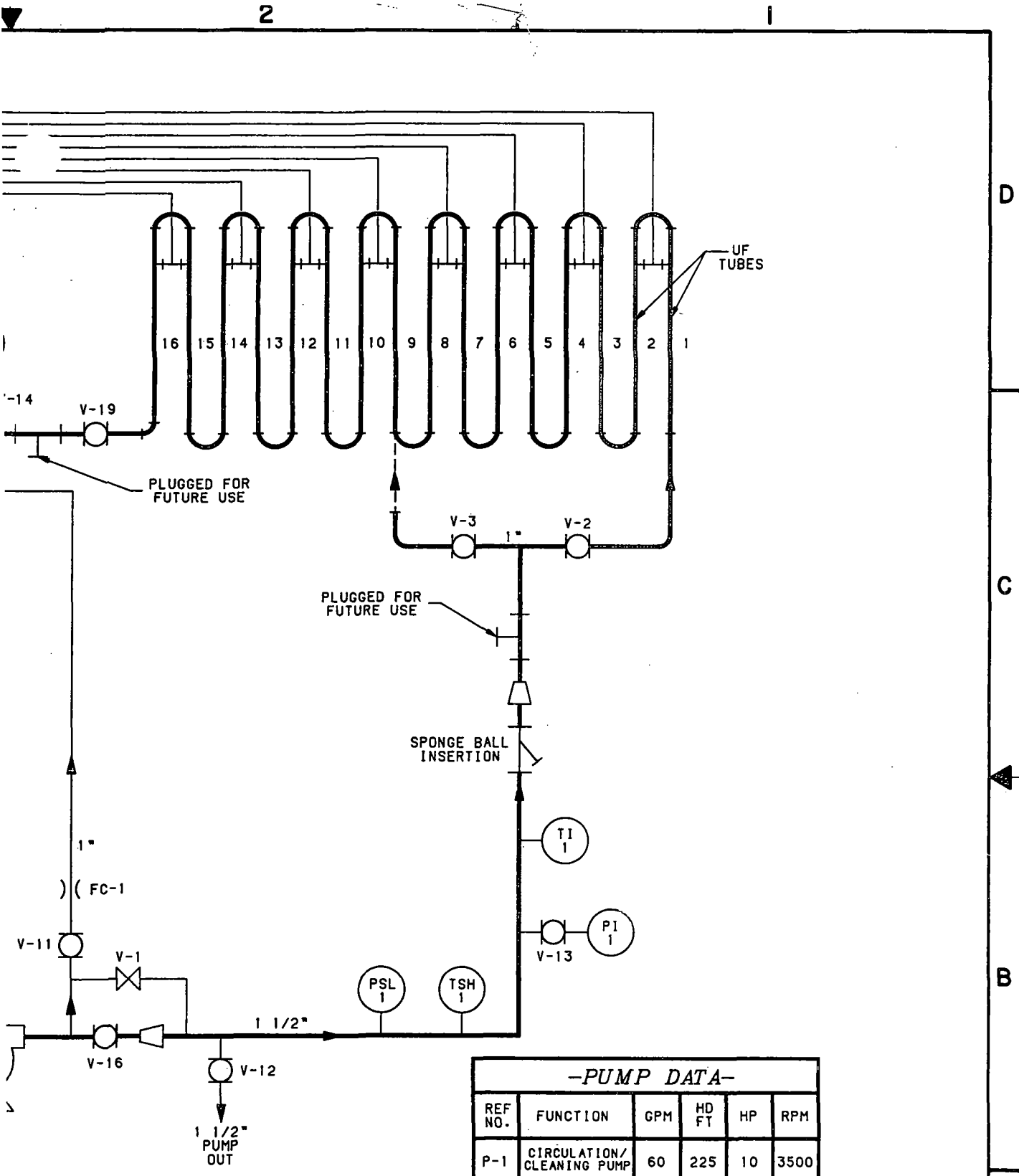


PANEL VIEW

SEPARATE PARTS LIST YES <input type="checkbox"/> NO <input type="checkbox"/>		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: ANGLES, ± FRACTIONS, ± DECIMALS, XXX±		NAME R. J.	DATE 9-23-88	KOCH KOCH MEMBRANE SYSTEMS INC. 850 Main Street Wilmington, Ma 01887	Abcor MEMBRANES
APPLICATION USED ON		MATERIAL: FINISH:		DRAWN CHECKED ENGINEER PROJ APP MICROFILM PROJ NO. MADE FROM	TITLE UF 1 X 16 PILOT SYSTEM ELECTRICAL SCHEMATIC		
						SCALE	SHEET 1 OF 3

ITEM	DRAWING	KMS NO.	DESCRIPTION	QTY.	COST	ITEM	DRAWING	KMS NO.	DESCRIPTION	QTY.	COST
108		0100306	WIRE-120	TRUCK	A/R	108			*****		
109		0100306	WIRE-120	CLAMP	A/R	109					
110		0100331	WIRE-6	90 BLOCK	A/R	110	MAIN		SWITCH: (WESTINGHOUSE) VISI-FLEX		
111		0100333	WIRE-6	END	A/R	111			DE-ION FUSIBLE DISCONNECT.		
112	WIRING		WIRING DIAG: LIGHT GRAY.			112			0313CS00010 FUSE KIT 30A 600V	1	
113			(PANELTY TYPE R.)			113	FUSES		FUSES: DUAL ELEMENT. (BOSS)		
114		0100370	SE 1 X 2 LG 6	FT.	A/R	114		0102000	600 VOLT.		
115		0100390	SC 1 LG 6	FT.	A/R	115			07R 20	3	
116	GROUND LGS	0105313	LGS. (SHEATH TYPE RA).			116	TRANSFORMER		TRANSFORMER: CONTROL.		
117			SEA 25		1	117			(WESTINGHOUSE TYPE MTA)		
118						118			575V TO 115V 60 HZ.		
119						119			01F0000 150 VA.	1	
120			THE FOLLOWING ITEMS ARE TO BE USED			120	STARTERS &		STARTERS: IEC. 120V, 60 HZ.		
121			FOR A LINE VOLTAGE OF 480 VOLTS.			121	RELAYS		RELAYS: IEC. 120V, 60 HZ.		
122			*****			122			(WESTINGHOUSE)		
123	MAIN	0104773	SWITCH: (WESTINGHOUSE) VISI-FLEX			123			08L17-10A CONTACTOR	1	
124			DE-ION FUSIBLE DISCONNECT.			124			08T12 OVERLOAD	1	
125			0313CS00010 FUSE KIT 30A 600V	1		125			08F1-20 AUX	1	
126	FUSES		FUSES: DUAL ELEMENT. (BOSS)			126			*****		
127		0102100	600 VOLT.			127			THE FOLLOWING ITEMS ARE TO BE USED		
128			07R 25	3		128			FOR A LINE VOLTAGE OF 208 VOLTS.		
129						129			*****		
130	TRANSFORMER		TRANSFORMER: CONTROL.			130	MAIN		SWITCH: (WESTINGHOUSE) VISI-FLEX		
131			(WESTINGHOUSE TYPE MTA)			131			DE-ION FUSIBLE DISCONNECT.		
132		0105025	230/480V TO 115V 60 HZ.			132			0313CS00009 FUSE KIT 30A 250V	1	
133			01F0007 150 VA.	1		133	FUSES		FUSES: DUAL ELEMENT. (BOSS)		
134	STARTERS &		STARTERS: IEC. 120V, 60 HZ.			134			250 VOLT.		
135	RELAYS		RELAYS: IEC. 120V, 60 HZ.			135			07R 50	3	
136		0104502	(WESTINGHOUSE)			136	TRANSFORMER		TRANSFORMER: CONTROL.		
137		0103118	08L17-10A CONTACTOR AB# 100-CL6010	1		137			(WESTINGHOUSE TYPE MTA)		
138		0104396	08T10 OVERLOAD AB# 193-EA168	1		138			208V TO 115V 60 HZ.		
139			08F1-20 AUX AB# 100-5A20	1		139		0105840	01F1028 150 VA.	1	
140			THE FOLLOWING ITEMS ARE TO BE USED			140	STARTERS &		STARTERS: IEC. 120V, 60 HZ.		
141			FOR A LINE VOLTAGE OF 230 VOLTS.			141	RELAYS		RELAYS: IEC. 120V, 60 HZ.		
142			*****			142			(WESTINGHOUSE)		
143	MAIN		SWITCH: (WESTINGHOUSE) VISI-FLEX			143			08L32-11A CONTACTOR	1	
144			DE-ION FUSIBLE DISCONNECT.			144			08T10 OVERLOAD	1	
145			0313CS00009 FUSE KIT 30A 250V	1		145			08F1-20 AUX	1	
146	FUSES		FUSES: DUAL ELEMENT. (BOSS)			146			*****		
147			250 VOLT.			147			END OF PARTS LIST		
148			07R 50	3		148			*****		
149	TRANSFORMER		TRANSFORMER: CONTROL.			149					
150			(WESTINGHOUSE TYPE MTA)			150					
151		0106025	230/480V TO 115V 60 HZ.			151					
152			01F0007 150 VA.	1		152					
153	STARTERS &		STARTERS: IEC. 120V, 60 HZ.			153					
154	RELAYS		RELAYS: IEC. 120V, 60 HZ.			154					
155			(WESTINGHOUSE)			155					
156			08L32-11A CONTACTOR	1		156					
157			08T10 OVERLOAD	1		157					
158			08F1-20 AUX	1		158					
159			THE FOLLOWING ITEMS ARE TO BE USED			159					
160			FOR A LINE VOLTAGE OF 575 VOLTS.			160					
161			*****			161					
162						162					
163						163					
164						164					
165						165					
166						166					
167						167					
168						168					
169						169					
170						170					
171						171					
172						172					
173						173					
174						174					
175						175					
176						176					
177						177					
178						178					
179						179					

IT	SEPARATE PARTS LIST		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: ANGLES, ± FRACTIONS, ± DECIMALS, XXX±	NAME	DATE	 KOCH KOCH MEMBRANE SYSTEMS INC 850 Main Street Wilmington, Ma. 01887	 Abcor MEMBRANE
	YES <input type="checkbox"/> NO <input type="checkbox"/>	DRAWN		R. J.	9-23-88		
	APPLICATION	CHECKED		(Signature)			
	USED ON	ENGINEER		A. C. (Signature)	9-23-88		
		MATERIAL:		PROJ APP		TITLE	
		FINISH:		MICROFILM		ELECTRICAL SCHEMATIC	
				PROJ NO.		KMS PART NO.	SIZE
				MADE FROM		0216377	D
						6733-6001	REV.
						C	
						SCALE	SHEET 3 OF 3



-PUMP DATA-					
REF NO.	FUNCTION	GPM	HD FT	HP	RPM
P-1	CIRCULATION/ CLEANING PUMP	60	225	10	3500

IS OTHERWISE SPECIFIED VISIONS ARE IN INCHES (AN) ON: IS FIL ALS, XX± XXX±	NAME	DATE	<div style="text-align: center;"> K KOCH KOCH MEMBRANE SYSTEMS INC 850 Main Street Wilmington, Ma. 01887 </div> <div style="text-align: right;"> </div>	
	DRAWN	R. J.		4-28-89
	CHECKED			11-8-89
	ENGINEER	JML		11-3-88
	PROJ APP			
MICROFILM				
TITLE UF 1 X 16 PILOT SYSTEM FLOW SCHEMATIC				
KMS PART NO.		SIZE	REV.	
		6733-5001		

3

2

1

NOTE:

①

1. THIS UNIT CAN BE SUPPLIED WITH SPIRAPAK I OPTION.
IF OPTION IS ELECTED SEE DWG REF 3 & 4.

2. ESTIMATED WEIGHTS:

SHIPPING - 1700 LBS

OPERATING - 4500 LBS.

5'-0" O.A.

PUMP
DISCH.

17 3/4

DATUM

7 EQUAL
SPACES @
4" = 28 TOTAL

26

21

ELECTRICAL
ENCLOSURE

19

46 1/2

DATUM

SEPARATE
PARTS LISTYES ☐ NO ☒

APPLICATION

USED ON

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
ANGLES: ±
FRACTIONS: XX±
DECIMALS: XXX±

MATERIAL:

FINISH:

NAME

DATE

DRAWN

JJC

10-6-89

CHECKED

ENGINEER

JJC

11-3-89

PROJ APP

MICROFILM

PROJ NO.

RA 23

MADE FROM

K KOCH**Abcor**
MEMBRANE

KOCH MEMBRANE SYSTEMS INC

850 Main Street Wilmington, Ma. 01887

TITLE UF 1 x 16 PILOT SYSTEM

OUTLINE DRAWING

KMS PART NO.

SIZE

D

6733-5002

REV.

F

SCALE 1/2" = 1'-0"

SHEET 1 OF 1

LF

1G

Q SPIRAPAK OPTION

2 PILOTS SPIRAPAK I OPTION

Appendix B: Membrane Spec Sheets

ABCOR[®] FEG[™] PLUS MODULE: 10-HFP-276-PVI

Industrial Tubular Ultrafiltration One-Inch Modules

PRODUCT DESCRIPTION

KMS Part Number (KPN):	0711650
Membrane Chemistry:	PVDF
Membrane Type:	HFP (negatively charged)
Membrane Area:	2.2 ft ² (0.20 m ²)
Molecular Weight Cut-off:	120,000 Dalton (nominal)
Housing Construction:	CPVC
Seal:	CPVC Insert (Epoxied in Place)
Gasket:	Viton [®]
Interconnecting Components:	See Reverse

OPERATING AND DESIGN INFORMATION*

Maximum Inlet Pressure:	90 psi @ 140°F (6.2 bar @ 60°C)
Minimum Outlet Pressure:	5 psi (0.3 bar)
Maximum Operating Temperature (at pH 8.0):	140°F (60°C)
Maximum Permeate Side Back Pressure:	5 psi (0.6 bar)
Maximum Feed Side Pressure Drop:	10 psi @ 140°F (0.7 bar @ 60°C)
Allowable pH - Continuous Exposure:	2.0 - 10.0 @ 140°F (60°C)
Allowable pH - Short Term Exposure:	1.5 - 10.5 @ 140°F (60°C)

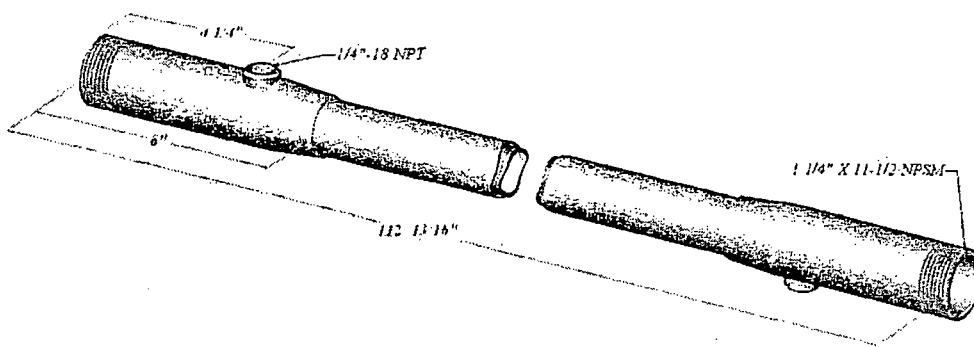
* Consult KMS Process Technology for specific applications.

FEED FLOW VS. PRESSURE DROP*

Circulation Flow		Crossflow Velocity		Pressure Drop	
gpm	m ³ /hr	fps	m/s	psi	bar
19	4.3	7.8	2.4	2.0	0.14
30	6.8	12.3	3.7	4.3	0.29
38	8.6	15.5	4.7	6.0	0.41

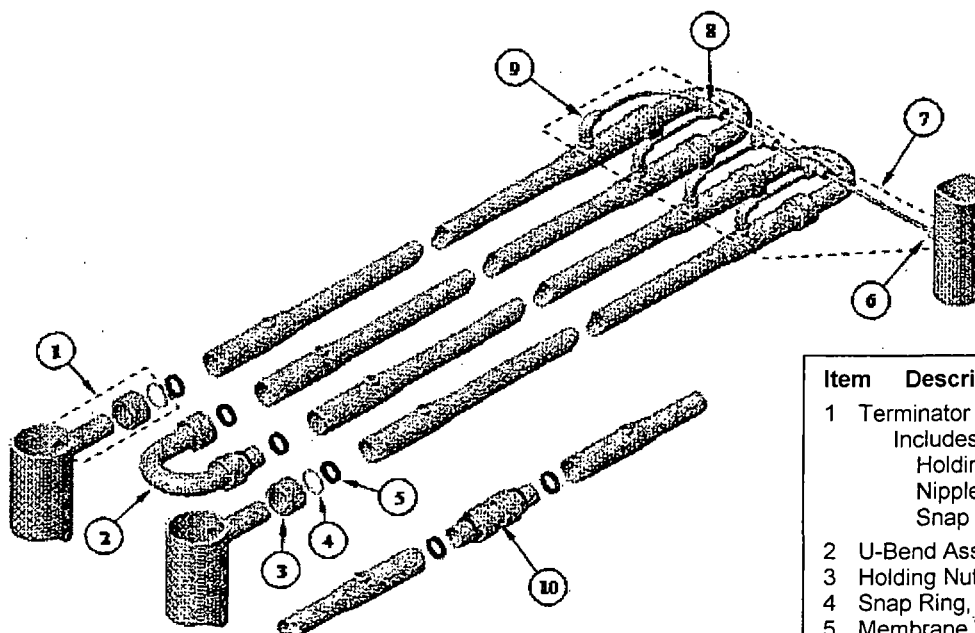
* Koch Membrane Systems, Inc. must review operating and cleaning conditions for all new plants as well as changes to any existing plants. Data based on Water at 77° F and a specific gravity of 1.0. Circulation rates exhibit variances of 15%.

NOMINAL DIMENSIONS



ANCILLARY PARTS

KMS recommends that these membranes be used with KMS supplied ancillary parts. Sealing is provided by o-rings and gaskets. No additional sealing compound or tape is recommended for use on threaded connections.



Item	Description	KPN
1	Terminator Kit Includes: Holding Nut, PVC (x2) Nipple, PVC (x2) Snap Ring, SS304 (x2)	0230020
2	U-Bend Assembly, CPVC	0020392
3	Holding Nut (PVC)	0020281
4	Snap Ring, SS304	0020310
5	Membrane Washer, Viton®	0020375
6	Permeate Straight Connector	0211800
7	Permeate Pass Kit (for 4 tubes) Includes: O-Ring 2-112 (x4) Adapter 1/4 to 3/8 (x1) Permeate Tee Connector (x4) Permeate Elbow Connector (x4) PE tubing	0211786
8	Permeate Tee Connector	0211803
9	Permeate Elbow Connector	0211804
10	Interconnector Kit, CPVC Includes: CPVC interconnector (x1) PVC Nut Holding (x2) Snap-Ring (x2)	0230091

MEMBRANE INCOMPATIBILITY

Prior to exposing the membrane to any chemical, the chemical should be reviewed by Koch Membrane Systems. Aside from the listed chemicals below, synthetic coolants, semi-synthetic coolants, kerosenes, naphtha, gasoline, floc polymers may affect membrane performance.

Chemicals that should be avoided include the following:

- Aprotic Solvent (e.g., Dimethyl Formamide, Dimethyl Acetamide, N-Methyl Pyrrolidine, etc.)
- Chlorinated Solvents (e.g., Methylene Chloride, Chloroform, Carbon Tetrachloride, etc.)
- Ketones (e.g., Acetone, Diacetone Alcohol, etc.)
- Silicones or Silicone based Defoamers (e.g., Siloxane)

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

Corporate Headquarters: 850 Main Street, Wilmington, Massachusetts 01887-3388, USA, Tel. Toll Free: 1-888-677-5624, Telephone: 1-978-694-7000, Fax: 1-978-657-5208

European Headquarters: Koch Chemical Technology Group Ltd., The Granary, Telegraph Street, Stafford ST17 4AT, United Kingdom, Telephone: +44-178-527-2500, Fax: +44-178-522-3149

• San Diego, California • Aachen, Germany • Lyon, France • Madrid, Spain • Milan, Italy • Wijnegem, Belgium • Beijing & Shanghai, China • Mumbai, India • Melbourne, Australia • Singapore • Sao Paulo, Brazil • Manama, Kingdom of Bahrain •

Viton® is a registered trademark of DuPont Dow Elastomers, LLC
 ABCOR® is a registered trademark of Koch Membrane Systems, Inc.
 Koch Membrane Systems, Inc. is a member of Koch Chemical Technology Group, LLC.
 © 2008 Koch Membrane Systems, Inc. All rights reserved worldwide. 04/08

ABCOR[®] FEG[™] PLUS MODULE: 10-HFM-251-PVI

Industrial Tubular Ultrafiltration One-Inch Modules

PRODUCT DESCRIPTION

KMS Part Number (KPN):	0711651
Membrane Chemistry:	PVDF
Membrane Type:	HFM (neutral)
Membrane Area:	2.2 ft ² (0.20 m ²)
Molecular Weight Cut-off:	100,000 Dalton (nominal)
Housing Construction:	CPVC
Seal:	CPVC Insert (Epoxied in Place)
Gasket:	Viton [®]
Interconnecting Components:	See Reverse

OPERATING AND DESIGN INFORMATION*

Maximum Inlet Pressure:	90 psi @ 140°F (6.2 bar @ 60°C)
Minimum Outlet Pressure:	5 psi (0.3 bar)
Maximum Operating Temperature (at pH 8.0):	140°F (60°C)
Maximum Permeate Side Back Pressure:	5 psi (0.6 bar)
Maximum Feed Side Pressure Drop:	10 psi @ 140°F (0.7 bar @ 60°C)
Allowable pH - Continuous Exposure:	2.0 - 10.0 @ 140°F (60°C)
Allowable pH - Short Term Exposure:	1.5 - 10.5 @ 140°F (60°C)

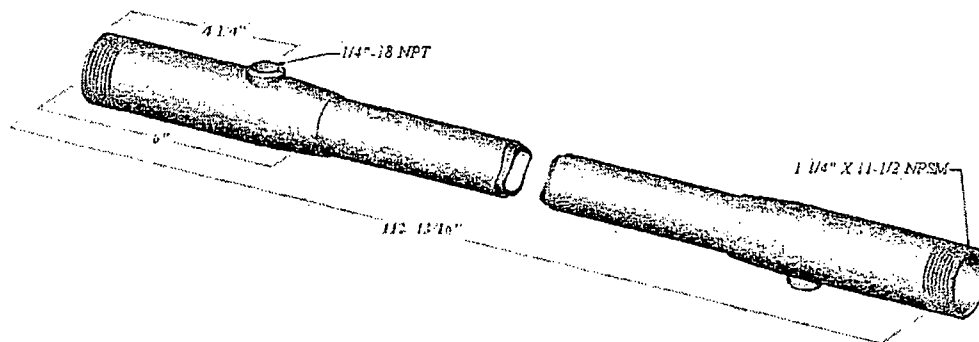
* Consult KMS Process Technology for specific applications.

FEED FLOW VS. PRESSURE DROP

Circulation Flow		Crossflow Velocity		Pressure Drop	
gpm	m ³ /hr	fps	m/s	psi	bar
19	4.3	7.8	2.4	2.0	0.14
30	6.8	12.3	3.7	4.3	0.29
38	8.6	15.5	4.7	6.0	0.41

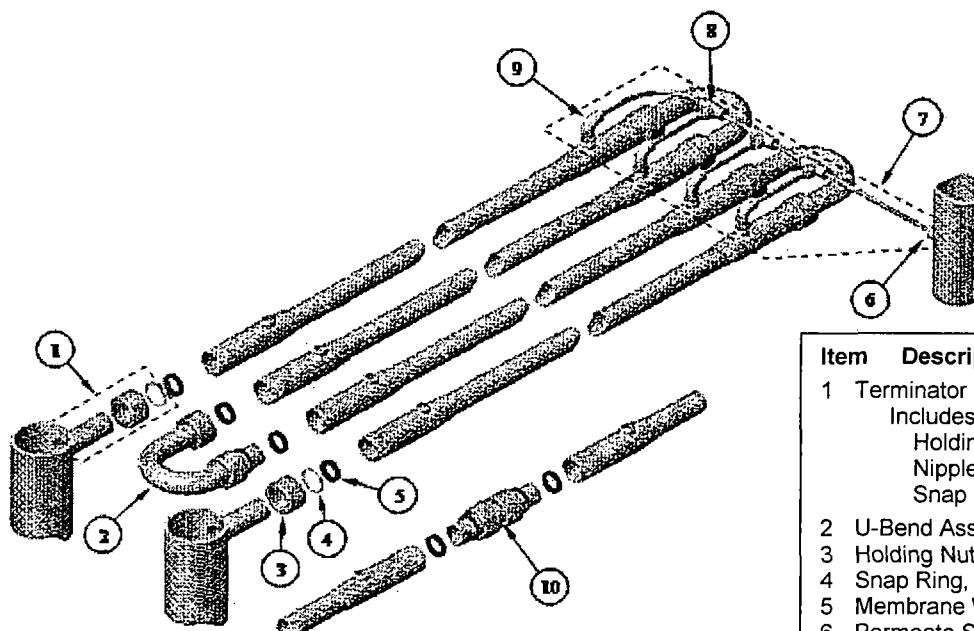
* Koch Membrane Systems, Inc. must review operating and cleaning conditions for all new plants as well as changes to any existing plants. Data based on Water at 77° F and a specific gravity of 1.0. Circulation rates exhibit variances of 15%.

NOMINAL DIMENSIONS



ANCILLARY PARTS

KMS recommends that these membranes be used with KMS supplied ancillary parts. Sealing is provided by o-rings and gaskets. No additional sealing compound or tape is recommended for use on threaded connections.



Item	Description	KPN
1	Terminator Kit Includes: Holding Nut, PVC (x2) Nipple, PVC (x2) Snap Ring, SS304 (x2)	0230020
2	U-Bend Assembly, CPVC	0020392
3	Holding Nut (PVC)	0020281
4	Snap Ring, SS304	0020310
5	Membrane Washer, Viton®	0020375
6	Permeate Straight Connector	0211800
7	Permeate Pass Kit (for 4 tubes) Includes: O-Ring 2-112 (x4) Adapter ¼ to ⅜ (x1) Permeate Tee Connector (x4) Permeate Elbow Connector (x4) PE tubing	0211786
8	Permeate Tee Connector	0211803
9	Permeate Elbow Connector	0211804
10	Interconnector Kit, CPVC Includes: CPVC interconnector (x1) PVC Nut Holding (x2) Snap-Ring (x2)	0230091

MEMBRANE INCOMPATIBILITY

Prior to exposing the membrane to any chemical, the chemical should be reviewed by Koch Membrane Systems. Aside from the listed chemicals below, synthetic coolants, semi-synthetic coolants, kerosenes, naphtha, gasoline, floc polymers may affect membrane performance.

Chemicals that should be avoided include the following:

- Aprotic Solvent (e.g., Dimethyl Formamide, Dimethyl Acetamide, N-Methyl Pyrrolidine, etc.)
- Chlorinated Solvents (e.g., Methylene Chloride, Chloroform, Carbon Tetrachloride, etc.)
- Ketones (e.g., Acetone, Diacetone Alcohol, etc.)
- Silicones or Silicone based Defoamers (e.g., Siloxane)

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

Corporate Headquarters: 850 Main Street, Wilmington, Massachusetts 01887-3388, USA, Tel. Toll Free: 1-888-677-5624, Telephone: 1-978-694-7000, Fax: 1-978-657-5208

European Headquarters: Koch Chemical Technology Group Ltd., The Granary, Telegraph Street, Stafford ST17 4AT, United Kingdom, Telephone: +44-178-527-2500, Fax: +44-178-522-3149

• San Diego, California • Aachen, Germany • Lyon, France • Madrid, Spain • Milan, Italy • Wijnegem, Belgium • Beijing & Shanghai, China • Mumbai, India • Melbourne, Australia • Singapore • Sao Paulo, Brazil • Manama, Kingdom of Bahrain •

Viton® is a registered trademark of DuPont Dow Elastomers, LLC
 ABCOR® is a registered trademark of Koch Membrane Systems, Inc.
 Koch Membrane Systems, Inc. is a member of Koch Chemical Technology Group, LLC.
 © 2008 Koch Membrane Systems, Inc. All rights reserved worldwide. 04/08

ABCOR® - ULTRA-COR® MODULE: 10-HFM-251-UVP

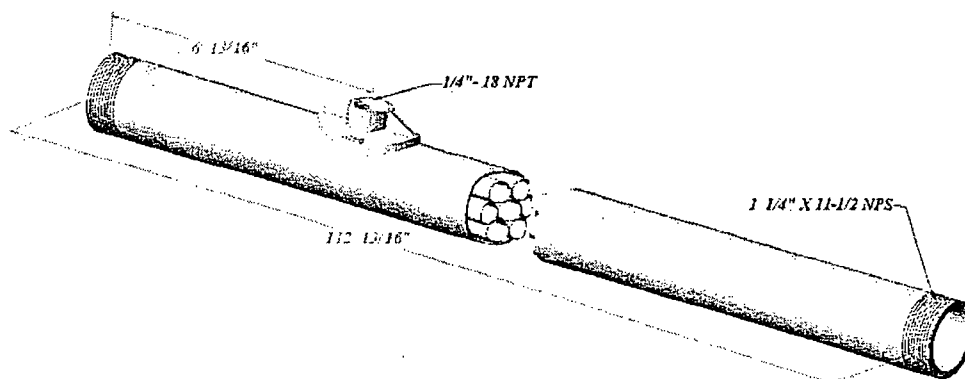
Industrial Ultrafiltration Multitubular Modules

PRODUCT DESCRIPTION	KMS Part Number (KPN):	0711952
	Membrane Chemistry:	PVDF
	Membrane Type:	HFM (neutral)
	Membrane Area:	7.2 ft ² (0.67 m ²)
	Molecular Weight Cut-off:	100,000 Dalton (nominal)
	Housing Construction:	PVC
	Seal:	PVC Insert (Epoxied in Place)
	Gasket:	Viton®
	Interconnecting Components:	See Reverse

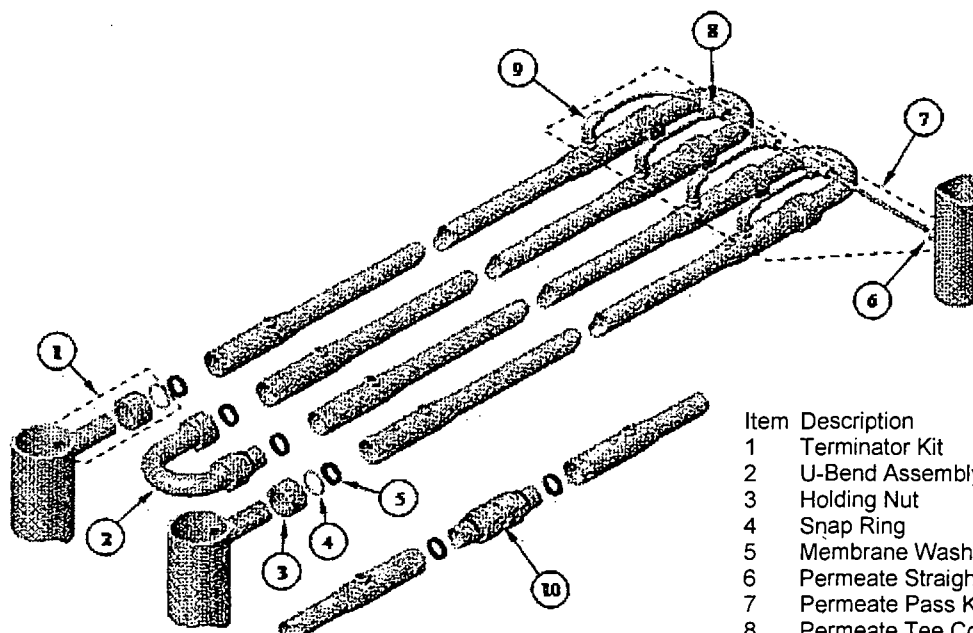
RECOMMENDED OPERATING LIMITS¹	Maximum Inlet Pressure:	70 psi @ 120°F (4.8 bar @ 49°C)
	Minimum Outlet Pressure:	5 psi (0.3 bar)
	Maximum Operating Temperature (at pH 8.0):	120°F (49°C)
	Maximum Permeate Side Back Pressure:	5 psi (0.6 bar)
	Maximum Feed Side Pressure Drop:	6.5 psi @ 120°F (0.4 bar @ 49°C)
	Allowable pH - Continuous Exposure:	2.0 - 10.0 @ 120°F (49°C)
	Allowable pH - Short Term Exposure:	1.5 - 10.5 @ 120°F (49°C)

FEED FLOW VS. PRESSURE DROP	Circulation Flow		Crossflow Velocity		Pressure Drop	
	gpm	m ³ /hr	fps	m/s	psi	bar
	23	5.2	6.4	2.0	2.0	0.14
	34	7.7	9.5	2.9	4.3	0.29
	42	9.5	11.7	3.6	6.0	0.41

PRODUCT DIMENSIONS



ANCILLARY PARTS²



Item	Description	KPN
1	Terminator Kit	0230020
2	U-Bend Assembly, CPVC	0020392
3	Holding Nut	0020281
4	Snap Ring	0020310
5	Membrane Washer, Viton®	0020375
6	Permeate Straight Connector	0211800
7	Permeate Pass Kit (for 4)	0211786
8	Permeate Tee Connector	0211803
9	Permeate Elbow Connector	0211804
10	Interconnector Kit, CPVC	0020456

MEMBRANE INCOMPATIBILITY³

Aprotic Solvents (Dimethyl Formamide, Dimethyl Acetamide, N-Methyl Pyrrolidine, etc.)

Chlorinated Solvents (Methylene Chloride, chloroform, Carbon Tetrachloride, etc.)

Ketones (Acetone, Diacetone Alcohol, etc.)

Silicones or Silicone based Defoamers (Siloxane)

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

¹ Koch Membrane Systems, Inc. must review operating and cleaning conditions for all new plants as well as changes to any existing plants. Data based on Water at 77° F and a specific gravity of 1.0. Circulation rates exhibit variances of 15%.

² KMS recommends that these membranes be used with KMS supplied ancillary parts. Sealing is provided by o-rings and gaskets. No additional sealing compound or tape is recommended for use on threaded connections.

³ Prior to exposing the membranes to any chemical, the chemical should be reviewed by Koch Membrane Systems, Inc. Aside from the listed chemicals, synthetic coolants, semi-synthetic coolants, kerosenes, naphtha, gasoline, floc polymers, etc., may affect membrane performance.

Koch Membrane Systems, Inc., www.kochmembrane.com

Corporate Headquarters: 850 Main Street, Wilmington, Massachusetts 01887-3388, USA, Tel. Toll Free: 1-888-677-5624, Telephone: 1-978-694-7000, Fax: 1-978-657-5208

European Headquarters: Koch Chemical Technology Group Ltd., The Granary, Telegraph Street, Stafford ST17 4AT, United Kingdom, Telephone: +44-178-527-2500, Fax: +44-178-522-3149

• San Diego, California • Aachen, Germany • Lyon, France • Madrid, Spain • Milan, Italy • Wijnegem, Belgium • Beijing & Shanghai, China • Mumbai, India • Melbourne, Australia • Singapore • Sao Paulo, Brazil • Manama, Kingdom of Bahrain •

Viton® is a registered trademark of DuPont Dow Elastomers, LLC
 ABCOR® and ULTRA-COR® are registered trademarks of Koch Membrane Systems, Inc.
 Koch Membrane Systems, Inc. is a Koch Chemical Technology Group, LLC company.
 © 2004 Koch Membrane Systems, Inc. All rights reserved worldwide. 04/07

Appendix C: Cleaning Water Quality Guidelines



KOCH MEMBRANE SYSTEMS WATER QUALITY GUIDELINES

For All Polymeric Membrane and Ion Exchange/Adsorbent Resin Applications

Parameter	MF/UF	NF/RO & IE/Abs. Resin
Turbidity	< 1.0 NTU	< 1.0 NTU
Suspended Solids (see Note 1)	< 5 mg/l	< 1 mg/l
Calcium (Ca)	< 10 mg/l	< 5 mg/l
Total Hardness (as CaCO ₃)	< 60 mg/l	< 30 mg/l
Iron (Fe)	< 0.05 mg/l	< 0.05 mg/l
Zinc (Zn)	< 0.3 mg/l	< 0.05 mg/l
Copper (Cu)	< 0.1 mg/l	< 0.05 mg/l
Manganese (Mn)	< 0.05 mg/l	< 0.02 mg/l
Aluminum (Al)	< 0.05 mg/l	< 0.05 mg/l
Silica, Reactive (as SiO ₂)	< 10 mg/l	< 10 mg/l
Silica, Colloidal (as SiO ₂)	< 1 mg/l	< 0.1 mg/l
Silicone	0 mg/l	0 mg/l
Total Bacteria Count (TBC)	< 1000 per ml	< 1000 per ml
E-Coli Count	0 per 100 ml	0 per 100 ml
Chlorine (as NaOCl)	< 1 mg/l	0 mg/l
D-Limonene (citrus applications only)	< 5 mg/l	0 mg/l
Fats, Oils and Grease	0 mg/l	0 mg/l
Total Organic Carbon (TOC)	< 1 mg/l	< 1 mg/l
pH (standard units)	6.5 - 7.5	6.5 - 7.5

1. The water supply must be free from particulate matter such as rust, scale, flakes, sandy and granular material, slurries, scum, algae and any chemical constituents that could foul or damage the membranes.
2. The water pH may need to be adjusted with acid or alkali depending on application and local conditions.
3. KMS membranes are available in many configurations and materials that may be affected differently by various water constituents. Softened water or evaporator condensate is generally acceptable for cleaning and flushing of polymeric membranes. Please consult with the KMS Process Group for the particular membrane in question.

Appendix D: Clean Water Flux Calculations

Clean Water Flux Calculations

Clean water flux. The clean water flux of the membrane is essential baseline information. It will be referenced later to determine cleanability of the membranes after tests on the process fluid at your location. As such, the clean membrane flux should be checked with a graduated cylinder and stopwatch in addition to the flowmeters supplied with the pilot unit.

With clean water in the cleaning tank, set the inlet and outlet pressures to 30 and 20 psi respectively. Quickly obtain a permeate flow rate. Record the following on the performance log: Pin, Pout, temperature, and permeate flow rate (gpm or lph). In the "Remarks" column of the data sheet, indicate "clean water flux". Also record the number of installed tubes on the log sheet.

The English unit of flux is gfd (gallons/ft²-day). Because the permeate rate is generally measured in gpm, a conversion is necessary:

$$\text{Uncorrected Water Flux (gfd)} = \text{Permeate Rate (gpm)} \times \frac{1,440 \text{ minutes / day}}{\text{Membrane Area}}$$

Membrane area for the UF-16 1×16 pilot unit is 35.2 ft² (or 2.2 ft² per FEG™ tube).

The water flux is also corrected for temperature and pressure (**Note: process flux is not corrected for temperature or pressure, only the water flux**). Standard conditions are 50 psi and 77°F and are corrected by the following equation:

$$\text{Water Flux}_{\text{uncorr}} \times \frac{50 \text{ psi}}{\text{Average Pressure}} \times F = \text{Water Flux}_{\text{corr}}$$

If the water flux was obtained with $P_{in} = 30$ and $P_{out} = 20$ psi, then the average pressure was 25 psi. The temperature correction factor "F" can be obtained from the attached table that gives the correction factors for different Fahrenheit and Celsius values.

Example: You observe a 2.0 gpm water flux operating at $P_{in} = 30$ and $P_{out} = 20$. Water temperature = 64°F (18°C) on the UF-16 1×16 pilot unit with 16 total tubes. The corrected flux is found by:

$$\begin{aligned} \text{Water Flux} &= \text{Permeate Rate}_{\text{gpm}} \times \frac{1,440 \text{ minutes / day}}{\text{Module Area}} \times \frac{50 \text{ psi}}{P_{\text{avg}}} \times F \\ 2.0 \text{ gpm} \times \frac{1,440 \text{ minutes / day}}{35.2 \text{ ft}^2} \times \frac{50 \text{ psi}}{25 \text{ psi}} \times 1.181 \\ &= 193 \text{ gfd}_c \end{aligned}$$

Expected clean membrane water flux ranges from 120 to 1,600 gfd_c depending on membrane type. After cleanings, a membrane that produces 120 gfd or greater is acceptable to put back on-line and continue to test on process fluids. Future clean membrane water flux following process tests will be lower than the initial flux, but this is normal. After a few runs this flux will level off and should then be attained after every proper cleaning procedure.

Note: Process flux is not corrected for temperature and pressure, only clean water flux is.

Water Flux Temperature Correction Factor (F)

$$Flux (25^{\circ}C) = Flux (T^{\circ}C) \times F$$

or

$$Flux (77^{\circ}F) = Flux (T^{\circ}F) \times F$$

Temp (°F)	Temp (°C)	F	Temp (°F)	Temp (°C)	F	Temp (°F)	Temp (°C)	F
125.6	52	0.595	96.8	36	0.793	68.0	20	1.125
123.8	51	0.605	95.0	35	0.808	66.2	19	1.152
122.0	50	0.615	93.5	34	0.825	64.4	18	1.181
120.2	49	0.625	91.4	33	0.842	62.6	17	1.212
118.4	48	0.636	89.6	32	0.859	60.8	16	1.243
116.6	47	0.647	87.8	31	0.877	59.0	15	1.276
114.8	46	0.658	86.0	30	0.896	57.2	14	1.320
113.0	45	0.670	84.2	29	0.915	55.4	13	1.346
111.2	44	0.682	82.4	28	0.935	53.6	12	1.383
109.4	43	0.694	80.6	27	0.956	51.8	11	1.422
107.6	42	0.707	78.8	26	0.978	50.0	10	1.463
105.8	41	0.720	77.0	25	1.000	48.2	9	1.506
104.0	40	0.734	75.2	24	1.023	46.4	8	1.551
102.2	39	0.748	73.4	23	1.047	44.6	7	1.598
100.4	38	0.762	71.6	22	1.072	42.8	6	1.648
98.6	37	0.777	69.8	21	1.098	41.0	5	1.699

Based on water fluidity relative to 25°C (77°F) fluidity value.

$$F = (\mu_{T^{\circ}C/25^{\circ}C}), \text{ or}$$

$$F = (\mu_{T^{\circ}F/77^{\circ}F})$$

Appendix E: Cleaning Chemical Spec Sheets and MSDS



KOCHKLEEN[®] 100 MEMBRANE CLEANER

Liquid, Acidic Membrane Cleaner for Low pH Cleaning

DESCRIPTION

KOCHKLEEN 100 membrane cleaner is a concentrated, proprietary blend of inorganic acids specifically formulated for superior low pH cleaning of membrane filtration systems.

COMPATIBLE MEMBRANES

Reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF).

APPLICATIONS

KOCHKLEEN 100 membrane cleaner is commonly used in food, dairy, pharmaceutical, industrial wastewater and general in-process applications.

ADVANTAGES

Improves membrane performance

- Formulated and tested by KMS filtration and chemical experts to provide superior membrane cleaning.
- Rapidly removes inorganic scale.
- Compatible with acid-resistant membranes.

Provides cost savings

- Concentrated formula promotes low use cost at recommended levels.
- Dispensable liquid mixes readily with water to reduce handling, mixing and cleaning time.
- Free-rinsing action. Surfactant-free formulation reduces cleaning cycle time and water use.

Safe to Use

- Suitable for incidental contact with food processing equipment. FDA opinion letter available.
- Compatible with 304 and 316 stainless steel, carbon steel, PVC, CPVC, EPDM and Viton[®] materials of construction.

PHYSICAL PROPERTIES

State: Liquid
Appearance: Clear
Odor: Nitric Acid
Solubility: Complete in water
@ 68 °F (20 °C)

Specific Gravity: 1.35 @ 68 °F (20 °C)
Freezing Point: ND
pH (1% solution): 1.3 – 1.9
Weight: 11.2 lbs/gallon (1.34 kg/L)

KOCHKLEEN® 100 MEMBRANE CLEANER

USE INSTRUCTIONS

- For typical cleaning-in-place (CIP), adjust pH to 1.8 – 2.0.
- Typical usage of KOCHKLEEN 100 membrane cleaner is 0.2 – 0.3% (v/v).
- NEVER use KOCHKLEEN 100 membrane cleaner for manual cleaning.
- Only use KOCHKLEEN 100 membrane cleaner in stainless steel equipment and piping which is equipped with acid-resistant pumps.
- Circulate final solution as required and recommended by KMS.
- Always consult the membrane manufacturer for specific procedures.

Refer to your Systems operating Manual or contact KMS Chemicals Group at 800-343-0499, fax at 978-694-7020, for specific cleaning temperatures and times. For precautionary measures and first aid information, refer to the Material Safety Data Sheet (MSDS) or the product label.

KMS PART NUMBERS

KOCHKLEEN® 100
KOCHKLEEN® 100

5 gallon (18.9 liter)
55 gallon (208.2 liter)

KPN 3410005
KPN 3410055

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

USA: 850 Main Street, Wilmington, MA 01887-3388, Telephone: 800-343-0499, Telephone: 978-657-4250, Fax: 978-657-5208

USA: 10054 Old Grove Road, San Diego, CA 92131, Telephone: 800-525-4369, Telephone: 858-695-3840, Fax 858-695-2176

UK: The Granary, Telegraph Street, Stafford, ST17 4AT, Telephone: +44-1785-272500, Fax: +44-1785-223149

AUSTRALIA: Suite 6, Level 1, 186-190 Church Street, Parramatta, NSW 2150, Tel: +61 2 8833 4640, Fax: +61 2 9689 3615

Viton® is a registered trademark of DuPont Dow Elastomers, LLC

KOCHKLEEN® is a registered trademark of Koch Membrane Systems, Inc.

Koch Membrane Systems, Inc. is a member of Koch Chemical Technology Group, LLC.

© 2004 Koch Membrane Systems, Inc. All rights reserved worldwide. 06/04



MATERIAL SAFETY DATA SHEET

1 CHEMICAL PRODUCT & COMPANY IDENTIFICATION

TRADE NAME(S) KOCHKLEEN® 100
CAS NUMBER MIXTURE
MSDS NUMBER 5705
PRODUCT CODE ND
SYNONYM(S) ND



MANUFACTURER / SUPPLIER Koch Membrane Systems, Inc.
850 Main Street
Wilmington, MA
01887 USA

TELEPHONE NUMBERS - 24 HOUR ASSISTANCE

Canutec: 613-996-6666
Chemtec: 800-424-9300

TELEPHONE NUMBERS - GENERAL ASSISTANCE

(8-5, M-F EST) Product 978-657-4250
Assistance

For technical assistance regarding this product, please contact your local Koch Membrane Systems representative.

2 COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient Name	CAS Number	Concentration*	Exposure Limits / Health Hazards
PHOSPHORIC ACID	7664-38-2	15 - 30 %	1 mg/m3 8-Hour TWA (OSHA) 1 mg/m3 8-Hour TWA (ACGIH) 3 mg/m3 15-Min STEL (ACGIH)
NITRIC ACID	7697-37-2	15 - 30 %	2 ppm 8-Hour TWA (OSHA) 2 ppm 8-Hour TWA (ACGIH) 4 ppm 15-Min STEL (ACGIH)

*Values do not reflect absolute minimums and maximums; these values are typical which may vary from time to time.

WHMIS Classification: E.

3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER!

HEALTH HAZARDS

CORROSIVE TO EYES AND SKIN.

MAY CAUSE BLINDNESS

HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.

ASPIRATION HAZARD IF SWALLOWED-CAN ENTER LUNGS AND CAUSE DAMAGE

**SEE "TOXICOLOGICAL INFORMATION" (SECTION 11) FOR MORE INFORMATION

FLAMMABILITY HAZARDS

NON-COMBUSTIBLE

REACTIVITY HAZARDS

STABLE

POTENTIAL HEALTH EFFECTS, SKIN

CORROSIVE. Contact may cause reddening, itching, inflammation, burns, blistering and possibly severe tissue damage.

POTENTIAL HEALTH EFFECTS, EYE

CORROSIVE. Exposure may cause severe burns, destruction of eye tissue and possible permanent injury or blindness.

POTENTIAL HEALTH EFFECTS, INHALATION

EXTREMELY IRRITATING AND CORROSIVE. Fumes or vapors from the heated material may be severely irritating and corrosive. Symptoms may include throat burns, constriction of the windpipe (bronchospasms), severe pulmonary edema and death, depending on the concentration and duration of exposure. Symptoms may include sore throat, coughing, labored breathing, sneezing and burning sensation, depending on the concentration and duration of exposure.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

Other specific symptoms of exposure are listed under "Toxicological Information" (Section 11).

POTENTIAL HEALTH EFFECTS, INGESTION

CORROSIVE. May cause painful irritation and burning of the mouth and throat, painful swallowing, labored breathing, burns or perforation of the gastrointestinal tract leading to ulceration and secondary infection. Symptoms may include salivation, pain, nausea, vomiting and diarrhea.

Aspiration into lungs may cause chemical pneumonia and lung damage.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

Other specific symptoms of exposure are listed under "Toxicological Information" (Section 11).

4 FIRST AID MEASURES

SKIN

Immediately flush skin with plenty of water, for at least 15 minutes, while removing contaminated clothing and shoes. GET IMMEDIATE MEDICAL ATTENTION.

Place contaminated clothing in closed container for storage until laundered or discarded. If clothing is to be laundered, inform person performing operation of contaminant's hazardous properties. Discard contaminated leather goods.

EYE

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

INHALATION

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen.

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

INGESTION

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Never give anything by mouth to an unconscious person. Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis.

Have victim rinse mouth thoroughly with water, then drink 8 to 10 oz. of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have the victim lean forward to reduce risk of aspiration. Repeat administration of water. Quickly transport to emergency care facility.

NOTES TO PHYSICIAN

This product is primarily an irritant and corrosive. As a corrosive, give attention to potential complication of esophagus or stomach perforations if ingested. Use of emetics and lavage are contraindicated. Necrosis and associated inflammatory processes peak at about 48 hours, but may extend up to four days. Initial healing processes occur during the period 4 to 14 days, but the esophageal wall is weakest during this period. Signs and symptoms of CNS depression, confusion and convulsions should be considered in the assessment and treatment of victims of exposures.

If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

5 FIRE FIGHTING MEASURES

HAZARDOUS COMBUSTION PRODUCTS

Combustion may produce NO_x, PO_x, acid fumes, nitrogen peroxide and hydrogen nitrate.

EXTINGUISHING MEDIA

Material itself will not burn.

BASIC FIRE FIGHTING PROCEDURES

Do not add water to acid. Water applied directly results in evolution of heat and splattering of acid. Acid can react with metals to liberate flammable hydrogen gas, especially when diluted with water. Evacuate area and fight fire from a safe distance. Use extinguishing agent suitable for type of surrounding fire.

Use water spray to cool adjacent structures and to protect personnel. Do not get water inside KOCHKLEEN® 100 containers. Shut off source of flow if possible. Stay away from storage tank ends. Withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Firefighters must wear MSHA/NIOSH approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

UNUSUAL FIRE & EXPLOSION HAZARDS

Material will not burn.

May have hazardous or explosive reactions with metallic powders, carbides or sulfides.

Flash Point	NA (WATER BASE)
Autoignition Temperature	ND
Flammability Limits in Air, Lower, % by Volume	ND
Flammability Limits in Air, Upper, % by Volume	ND

6 ACCIDENTAL RELEASE MEASURES

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. Evacuate area endangered by release as required. (See Exposure Control/Personal Protection - Section 8).

ENVIRONMENTAL PRECAUTIONS

If product is released to the environment, take immediate steps to stop and contain release. Caution should be exercised regarding personnel safety and exposure to the released product. Notify local, provincial and/or federal authorities, if required.

SPILL OR LEAK PROCEDURE

Keep unnecessary people away. Isolate area for at least 25-50 meters (80-160 feet) to preserve public safety. For large spills, consider initial evacuation for at least 300 meters (1000 feet).

Large spills may be neutralized with dilute alkaline solutions of soda ash or lime. Stop leak when safe to do so.

Do not touch or walk through spilled material.

See Exposure Controls/Personal Protection (Section 8).

7 HANDLING & STORAGE

HANDLING

This material should be stored and shipped in plastic or plastic lined containers. Do not use with materials or equipment sensitive to acidic solutions.

Do not eat, drink or smoke in areas of use or storage.

STORAGE

Avoid contact with strong oxidizers, bases, chlorine releasers and metals. Store in tightly closed containers in cool, dry area away from heat and incompatibles.

Empty containers may contain product residue. Do not reuse without adequate precautions.

Ship or store only in containers that meet the specifications for corrosives, packing group I.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

General or local exhaust ventilation and other forms of engineering controls are the preferred means for controlling exposures.

EYE PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Wear chemical safety goggles and face shield. Have eye washing facilities readily available where eye contact can occur.

SKIN PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Avoid skin contact with this material. If skin contact is anticipated, protective clothing, including impervious gloves, should be worn.

Additional protection may be necessary to prevent skin contact including use of apron, armcovers, face shield, or boots. Provide safety showers at any location where skin contact can occur.

Use good personal hygiene.

RESPIRATORY PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

A NIOSH/MSHA approved air purifying respirator with an acid vapor cartridge or canister may be appropriate under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

9 PHYSICAL & CHEMICAL PROPERTIES

ODOR AND APPEARANCE

CLEAR, COLORLESS LIQUID WITH AN ACIDIC ODOR

Boiling Point	212 °F (100 °C)
Specific Gravity	1.4
Melting Point	NA
Percent Volatile	50 - 70 %
Vapor Pressure	ND
Vapor Density	2 - 3 (NITRIC ACID); 3.4 (PHOSPHORIC ACID)
Bulk Density	10.51 LBS/GAL
Solubility in Water	100 %
Octanol/Water Partn	ND
Volatile Organic	NA
Pour Point	NA
pH Value	< 1
Freezing Point	ND
Viscosity	ND
Evaporation Rate	ND
Molecular Formula	NA
Molecular Weight	ND
Chemical Family	MINERAL ACID
Odor Threshold	0.75 mg/m3 (NITRIC ACID)

10 STABILITY & REACTIVITY

STABILITY/INCOMPATIBILITY

Incompatible with bases and chlorine releasers. Avoid contact with metals. See precautions under Handling & Storage (Section 7).

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS

Combustion may produce NO_x, PO_x, acid fumes, nitrogen peroxide and hydrogen nitrate.

11 TOXICOLOGICAL INFORMATION

ROUTES OF EXPOSURE

Inhalation, ingestion, skin and eye contact.

LD50

ND

TOXICOLOGICAL DATA

Acute or chronic overexposure to this material or its components may cause systemic toxicity, including adverse effects to the following: skin, eye, teeth, blood and respiratory system.

Exposure to components of this material may cause the following specific symptoms, depending on the concentration and duration of exposure: chronic obstructive pulmonary disease, erosion of teeth and chest pains. Other symptoms of exposure may include the following: cardiovascular collapse, acidosis, bloody diarrhea, bloody vomit and shock.

PRE-EXISTING CONDITIONS AGGRAVATED BY EXPOSURE

Pre-existing medical conditions which may be aggravated by exposure include disorders of the skin, eye respiratory and cardiovascular systems.

12 ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

ND

13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

This product, as supplied, when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR 261) due to its corrosivity. Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user of the product to determine, at the time of disposal, whether the material is a hazardous waste subject to RCRA.

The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.

In Canada, wastes should be disposed of according to federal, state, provincial and local regulations.

14 TRANSPORT INFORMATION

BILL OF LADING - BULK (U. S. DOT)

Corrosive Liquid, Acidic, Inorganic, N.O.S. (Nitric Acid, Phosphoric Acid), 8, UN3264, PG I

BILL OF LADING - NON-BULK (U. S. DOT)

Corrosive Liquid, Acidic, Inorganic, N.O.S. (Nitric Acid, Phosphoric Acid), 8, UN3264, PG I

The above description may not cover shipping in all cases, please consult 49 CFR 172.101 for specific shipping information.

15 REGULATORY INFORMATION

FEDERAL REGULATIONS

All components of this product are listed on the TSCA Inventory.

This product, as supplied, contains phosphoric acid, a Hazardous Substance as per 40 CFR Part 302.4. The reportable quantity for phosphoric acid is 5000 pound(s). Any release of this product that results in a release of phosphoric acid equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and 40 CFR 355.40, respectively.

This product, as supplied, contains nitric acid, a Hazardous Substance as per 40 CFR Part 302.4 and an Extremely Hazardous Substance as per 40 CFR Part 355. The reportable quantity for nitric acid is 1000 pounds. Any release of this product equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and 40 CFR 355.40, respectively. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Failure to report may result in substantial civil and criminal penalties.

This product contains nitric acid which is listed as an extremely hazardous substance and is subject to the notification and inventory reporting requirements of the Superfund Amendments and Reauthorization Act (SARA) Section 302 (40 CFR 355) and Section 311/312, respectively.

This product contains one or more components designated as hazardous substances or toxic pollutants pursuant to the Federal Clean Water Act (40 CFR 116.4 Table A; 40 CFR 401.15). Any unpermitted introduction of this product into a facility stormwater or wastewater discharge may constitute a violation of the Clean Water Act. Facilities must notify the appropriate permitting agency prior to introducing this product into the aforementioned discharges.

There may be specific regulations at the local, regional or state/provincial level that pertain to this product.

SARA TITLE III RATINGS

Immediate Hazard:	X	Delayed Hazard:	-	Fire Hazard:	-	Pressure Hazard:	-
Reactivity Hazard:	-						

Following ingredients of this product are listed in SARA313

SARA Listed Ingredient Name	CAS Number	Maximum %
NITRIC ACID	7697-37-2	30.0

STATE REGULATIONS

Based on available information this product does not contain any components or chemicals currently known to the State of California to cause cancer, birth defects or reproductive harm at levels which would be subject to Proposition 65. Reformulation, use or processing of this product may affect its composition and require re-evaluation.

PENNSYLVANIA - Non-hazardous ingredients present at >3%: Water, CAS # 7732-18-5

INTERNATIONAL REGULATIONS

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and this MSDS contains all the information required by the CPR.

WHMIS Classification: E.

All known major components of this product are listed on the Canadian DSL.

WHMIS RATINGS

Compressed Gas	Flammable/Combustible	Oxidizer		Acutely Toxic
Other Toxic Effects	Bio Hazardous	Corrosive	X	Dangerously Reactive

NFPA RATINGS

Health	3	Flammability	0	Reactivity	0	Special Hazards
--------	---	--------------	---	------------	---	-----------------

HMIS RATINGS

Health	3	Flammability	0	Reactivity	0
--------	---	--------------	---	------------	---

OTHER INFORMATION**DISCLAIMER**

NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, MSDS may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, expressed or implied, is made as to the accuracy or comprehensiveness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Current Revision Date 07-Apr-2005

Replaces Sheet Dated 07-Apr-2005

Completed By Safety & Emergency Response, Koch Chemical Technology Group, LLC



KOCHKLEEN[®] 222 MEMBRANE CLEANER

Liquid, Alkaline Membrane Cleaner - Chlorine-Free and EDTA-Free Formula

DESCRIPTION	KOCHKLEEN 222 membrane cleaner is a specially formulated, chlorine-free and EDTA-free, alkaline membrane cleaner.
--------------------	---

COMPATIBLE MEMBRANES	Reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF) membranes.
-----------------------------	---

APPLICATIONS	KOCHKLEEN 222 membrane cleaner is commonly used in food, dairy, beverage, pharmaceutical, industrial wastewater and general in-process applications.
---------------------	--

ADVANTAGES	<p>Improves Membrane Performance</p> <ul style="list-style-type: none">• Formulated and tested by KMS filtration and chemical experts to provide superior membrane cleaning.• Improves membrane performance and maximizes production capabilities by loosening, dissolving and effectively removing the membrane fouling layer.• Removes fats, proteins and inorganic foulants. <p>Provides Cost Savings</p> <ul style="list-style-type: none">• Concentrated formula promotes low use cost at recommended levels.• Dispensable liquid that readily mixes with aqueous solutions to reduce handling and cleaning time.• Formulation maximizes membrane life by avoiding high alkaline concentration spikes during cleaning chemicals addition.• Free-rinsing action. Surfactant-free formulation reduces cleaning cycle time and water use. <p>Safe to Use</p> <ul style="list-style-type: none">• Suitable for incidental contact with food processing equipment. FDA opinion letter available.• Environmentally responsible, CHLORINE-FREE and EDTA-FREE formulation.• Compatible with alkaline and oxygenated KOCHKLEEN membrane cleaners enabling use over a wide range of membrane applications and operating parameters.
-------------------	--

PHYSICAL PROPERTIES

State:	Liquid
Appearance:	Clear to light amber
Odor:	Pungent
Solubility:	Complete in water @ 68 °F (20 °C)

Specific Gravity:	1.317 @ 68 °F (20 °C)
Freezing Point:	ND
pH (1% solution):	> 12.55
Weight:	10.7 lbs./gallon (1.28 kg/L)

KOCHKLEEN® 222 MEMBRANE CLEANER

USE INSTRUCTIONS

- For typical cleaning-in-place (CIP) applications, use 0.2 - 2.0% (v/v) KOCHKLEEN 222 membrane cleaner depending on membrane type and pH limitations.
- Circulate as required and recommended by KMS.
- Always consult the membrane manufacturer for specific procedures.

Refer to your Systems operating Manual or contact KMS Chemicals Group at 800-343-0499, fax at 978-694-7020, for specific cleaning temperatures and times. For precautionary measures and first aid information, refer to the Material Safety Data Sheet (MSDS) or the product label.

KMS PART NUMBERS

KOCHKLEEN® 222
KOCHKLEEN® 222

5 gallon (18.9 liter)

55 gallon (208.2 liter)

KPN 3430005

KPN 3430055

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

USA: 850 Main Street, Wilmington, MA 01887-3388, Telephone: 800-343-0499, Telephone: 978-657-4250, Fax: 978-657-5208

USA: 10054 Old Grove Road, San Diego, CA 92131, Telephone: 800-525-4369, Telephone: 858-695-3840, Fax 858-695-2176

UK: The Granary, Telegraph Street, Stafford, ST17 4AT, Telephone: +44-1785-272500, Fax: +44-1785-223149

AUSTRALIA: Suite 6, Level 1, 186-190 Church Street, Parramatta, NSW 2150, Tel: +61 2 8833 4640, Fax: +61 2 9689 3615

KOCHKLEEN® is a registered trademark of Koch Membrane Systems, Inc.
Koch Membrane Systems, Inc. is a member of Koch Chemical Technology Group, LLC.
© 2004 Koch Membrane Systems, Inc. All rights reserved worldwide. 06/04

06/04 Technical Data Sheet



MATERIAL SAFETY DATA SHEET

1 CHEMICAL PRODUCT & COMPANY IDENTIFICATION

TRADE NAME(S) **KOCHKLEEN® 222**
CAS NUMBER MIXTURE
MSDS NUMBER 9036
PRODUCT CODE ND
PRODUCT USE CLEANING AGENT



MANUFACTURER / SUPPLIER Koch Membrane Systems, Inc.
850 Main Street
Wilmington, MA
01887 USA

TELEPHONE NUMBERS - 24 HOUR ASSISTANCE

Canutec: 613-996-6666
Chemtec: 800-424-9300 (inside USA)
+1-703-527-3887 (outside USA)

TELEPHONE NUMBERS - GENERAL ASSISTANCE

(8-5, M-F EST) Product 978-657-4250
Assistance

For technical assistance regarding this product, please contact your local Koch Membrane Systems representative.

2 COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient Name	CAS Number	Concentration*	Exposure Limits / Health Hazards
SODIUM HYDROXIDE	1310-73-2	15 - 30 %	2 mg/m3 8-Hour TWA (OSHA) 2 mg/m3 CEILING (ACGIH)
DECYL(SULFOPHENOXY) BENZENESULFONIC ACID, DISODIUM SALT	36445-71-3	1 - 5 %	ND

*Values do not reflect absolute minimums and maximums; these values are typical which may vary from time to time.

WHMIS Classification: D2B, E.

3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER!

HEALTH HAZARDS

CORROSIVE TO THE SKIN, EYES AND RESPIRATORY TRACT
OVEREXPOSURE MAY CAUSE TEMPORARY OR PERMANENT BLINDNESS
MAY BE HARMFUL OR FATAL IF SWALLOWED

**SEE "TOXICOLOGICAL INFORMATION" (SECTION 11) FOR MORE INFORMATION

FLAMMABILITY HAZARDS

NON-COMBUSTIBLE

REACTIVITY HAZARDS

STABLE

POTENTIAL HEALTH EFFECTS, SKIN

CORROSIVE. Contact may cause reddening, itching, inflammation, burns, blistering and possibly severe tissue damage. Burns may not become symptomatic for several hours after contact.

POTENTIAL HEALTH EFFECTS, EYE

CORROSIVE. Exposure may cause severe burns, destruction of eye tissue and possible permanent injury or blindness.

Exposure may cause sensitivity to light.

POTENTIAL HEALTH EFFECTS, INHALATION

EXTREMELY IRRITATING AND CORROSIVE. Symptoms may include throat burns, constriction of the windpipe (bronchospasms), severe pulmonary edema and death, depending on the concentration and duration of exposure. Symptoms may include sore throat, coughing, labored breathing, sneezing and burning sensation, depending on the concentration and duration of exposure.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

Other specific symptoms of exposure are listed under "Toxicological Information" (Section 11).

POTENTIAL HEALTH EFFECTS, INGESTION

CORROSIVE. May cause painful irritation and burning of the mouth and throat, painful swallowing, labored breathing, burns or perforation of the gastrointestinal tract leading to ulceration and secondary infection.

Aspiration into lungs may cause chemical pneumonia and lung damage.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

4 FIRST AID MEASURES

SKIN

Immediately flush skin with plenty of water, for at least 15 minutes, while removing contaminated clothing and shoes. GET IMMEDIATE MEDICAL ATTENTION.

Place contaminated clothing in closed container for storage until laundered or discarded. If clothing is to be laundered, inform person performing operation of contaminant's hazardous properties. Discard contaminated leather goods.

EYE

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

INHALATION

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen.

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

INGESTION

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Never give anything by mouth to an unconscious person. Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis.

Have victim rinse mouth thoroughly with water, then drink 8 to 10 oz. of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have the victim lean forward to reduce risk of aspiration. Repeat administration of water. Quickly transport to emergency care facility.

NOTES TO PHYSICIAN

If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

Treat as an alkali corrosive; these agents damage the gastrointestinal tract by liquefaction necrosis which permits deep tissue penetration. Severe alkali burns may extend to adjacent viscera. Acute symptoms may not indicate the severity of tissue injury, but signs of chronic injury may include drooling, inability to swallow, erythema and/or ulceration of the oral pharynx, hematemesis, and occasionally shock and respiratory distress. Necrosis and associated inflammatory processes peak at 48 hours, but extend up to 4 days. Initial healing processes occur during the period of 4-14 days, but the esophageal wall is the weakest during this period and the hazard of perforation is greatest.

5 FIRE FIGHTING MEASURES

HAZARDOUS COMBUSTION PRODUCTS

Combustion may produce sodium oxides, peroxides, sulfides and carbonates.

EXTINGUISHING MEDIA

Use water spray, dry chemical, alcohol foam, all purpose AFFF or carbon dioxide to extinguish fire.

BASIC FIRE FIGHTING PROCEDURES

Evacuate area and fight fire from a safe distance.

Use water spray to cool adjacent structures and to protect personnel. Shut off source of flow if possible. Stay away from storage tank ends. Withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Firefighters must wear MSHA/NIOSH approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

Flash Point	PRODUCT DOES NOT FLASH
Autoignition Temperature	NA
Flammability Limits in Air, Lower, % by Volume	NA
Flammability Limits in Air, Upper, % by Volume	NA

6 ACCIDENTAL RELEASE MEASURES

EMERGENCY ACTION

Keep unnecessary people at least 150 feet upwind of spill; greater distances may be necessary for people downwind. Isolate hazard area and deny entry. See Exposure Control/Personal Protection (Section 8).

ENVIRONMENTAL PRECAUTIONS

If product is released to the environment, take immediate steps to stop and contain release. Caution should be exercised regarding personnel safety and exposure to the released product.

Notify local, provincial and/or federal authorities, if required.

SPILL OR LEAK PROCEDURE

Keep unnecessary people away. Isolate area for at least 25-50 meters (80-160 feet) to preserve public safety. For large spills, consider initial evacuation for at least 300 meters (1000 feet).

Large Spills: Dike far ahead of spill to contain until disposal. Neutralize spill with a weak acid such as vinegar or acetic acid. Stop leak when safe to do so.

Do not touch or walk through spilled material.

See Exposure Controls/Personal Protection (Section 8).

7 HANDLING & STORAGE

HANDLING

Do not inhale vapors or mists.

Do not eat, drink or smoke in areas of use or storage.

STORAGE

Store in tightly closed containers in cool, dry area away from heat and incompatibles. Avoid contact with strong oxidizers, acids, metals, explosives and organic peroxides.

Empty containers may contain product residue. Do not reuse without adequate precautions.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

General or local exhaust ventilation and other forms of engineering controls are the preferred means for controlling exposures.

EYE PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Wear chemical safety goggles and face shield. Have eye washing facilities readily available where eye contact can occur.

SKIN PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Avoid skin contact with this material.

If skin contact is anticipated, protective clothing, including impervious gloves, should be worn. Additional protection may be necessary to prevent skin contact including use of apron, armcovers, face shield, or boots. Provide safety showers at any location where skin contact can occur.

Use good personal hygiene.

RESPIRATORY PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

A NIOSH/MSHA approved air purifying respirator with a HEPA cartridge or canister may be appropriate under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

9 PHYSICAL & CHEMICAL PROPERTIES

ODOR AND APPEARANCE

CLEAR, LIGHT AMBER COLORED LIQUID WITH PUNGENT ODOR

Boiling Point	ND
Specific Gravity	1.317 AT 68 °F (20 °C)
Melting Point	ND
Percent Volatile	ND
Vapor Pressure	ND
Vapor Density	ND
Bulk Density	10.6 LBS/GAL
Solubility in Water	100 % COMPLETELY MISCIBLE
Octanol/Water Partn	ND
Volatile Organic	ND
Pour Point	ND
pH Value	> 13 [11.84 (1% solution)]
Freezing Point	ND
Viscosity	ND
Evaporation Rate	ND
Molecular Formula	ND
Molecular Weight	MIXTURE
Chemical Family	ALKALI HYDROXIDE
Odor Threshold	ND

10 STABILITY & REACTIVITY

STABILITY/INCOMPATIBILITY

Incompatible with strong oxidizing agents & acids, chlorinated hydrocarbons, peroxides, tin, zinc, copper, bronze and brass. Generates heat when mixed with water or acids.

See precautions under Handling & Storage (Section 7).

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS

Combustion may produce sodium oxides, peroxides, sulfides and carbonates.

Contact with metals such as aluminum, tin and zinc can generate hydrogen, a highly flammable gas.

Corrosion of metal can occur at temperatures above 140 °F (60 °C). Absorbs carbon dioxide from the air to form carbonates.

11 TOXICOLOGICAL INFORMATION

ROUTES OF EXPOSURE

Inhalation, ingestion, skin and eye contact.

TOXICOLOGICAL DATA

Acute or chronic overexposure to this material or its components may cause systemic toxicity, including adverse effects to the following: kidney, liver, skin, eyes and respiratory system.

Exposure to components of this material may cause the following specific symptoms, depending on the concentration and duration of exposure: bloody vomit and cardiovascular collapse.

CARCINOGENICITY

Ingredients in the product are not listed by NTP, IARC or OSHA.

PRE-EXISTING CONDITIONS AGGRAVATED BY EXPOSURE

Pre-existing medical conditions which may be aggravated by exposure include disorders of the skin, eye and respiratory system.

12 ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Contains substance(s) that may be moderately toxic to aquatic organisms on an acute basis (LD50/EC50 between 1 and 10 mg/l in the most sensitive species tested).

13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

This product, as supplied, when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR 261) due to its corrosivity.. Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user of the product to determine, at the time of disposal, whether the material is a hazardous waste subject to RCRA.

The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.

In Canada, wastes should be disposed of according to federal, state, provincial and local regulations.

14 TRANSPORT INFORMATION

BILL OF LADING - BULK (U. S. DOT)

Sodium Hydroxide Solution, 8, UN1824, PG II

BILL OF LADING - NON-BULK (U. S. DOT)

Sodium Hydroxide Solution, 8, UN1824, PG II

The above description may not cover shipping in all cases, please consult 49 CFR 172.101 for specific shipping information.

15 REGULATORY INFORMATION

FEDERAL REGULATIONS

All components of this product are listed on the TSCA Inventory.

This product, as supplied, contains sodium hydroxide, a Hazardous Substance as per 40 CFR Part 302.4. The reportable quantity for sodium hydroxide is 1000 pound(s). Any release of this product that results in a release of sodium hydroxide equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and 40 CFR 355.40, respectively. Failure to report may result in substantial civil and criminal penalties. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations.

This product does not contain toxic chemicals (in excess of the applicable de minimis concentration) that are subject to the annual toxic chemical release reporting requirements of the Superfund Amendments and Reauthorization Act (SARA) Section 313 (40 CFR 372).

This product contains one or more components designated as hazardous substances or toxic pollutants pursuant to the Federal Clean Water Act (40 CFR 116.4 Table A; 40 CFR 401.15). Any unpermitted introduction of this product into a facility stormwater or wastewater discharge may constitute a violation of the Clean Water Act. Facilities must notify the appropriate permitting agency prior to introducing this product into the aforementioned discharges.

There may be specific regulations at the local, regional or state/provincial level that pertain to this product.

SARA TITLE III RATINGS

Immediate Hazard:	X	Delayed Hazard:	X	Fire Hazard:	-	Pressure Hazard:	-
Reactivity Hazard:	-						

STATE REGULATIONS

Based on available information this product does not contain any components or chemicals currently known to the State of California to cause cancer, birth defects or reproductive harm at levels which would be subject to Proposition 65. Reformulation, use or processing of this product may affect its composition and require re-evaluation.

PENNSYLVANIA - Non-hazardous ingredients present at >3%: Water, CAS# 7732-18-5

INTERNATIONAL REGULATIONS

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and this MSDS contains all the information required by the CPR.

WHMIS Classification: D2B, E.

All known major components of this product are listed on the Canadian DSL.

WHMIS RATINGS

Compressed Gas		Flammable/Combustible		Oxidizer		Acutely Toxic	
Other Toxic Effects	X	Bio Hazardous		Corrosive	X	Dangerously Reactive	

NFPA RATINGS

Health	3	Flammability	0	Reactivity	0	Special Hazards	-
--------	---	--------------	---	------------	---	-----------------	---

HMIS RATINGS

Health	3	Flammability	0	Reactivity	0
--------	---	--------------	---	------------	---

16 OTHER INFORMATION

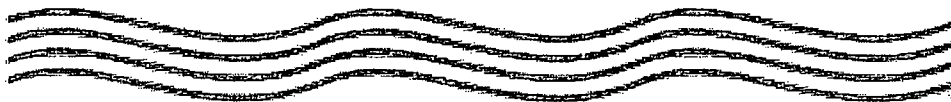
DISCLAIMER

NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, MSDS may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, expressed or implied, is made as to the accuracy or comprehensiveness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Current Revision Date 19-May-2008

Replaces Sheet Dated 17-Apr-2005

Completed By Koch Chemical Technology Group, LLC, call (978) 694-7346 or (978) 657-4250



KOCHKLEEN[®] UC III MEMBRANE CLEANER

Concentrated, Liquid Nonionic Surfactant Membrane Cleaner

DESCRIPTION

KOCHKLEEN UC III membrane cleaner is a specially formulated, concentrated nonionic detergent commonly used to dissolve and remove fats, proteins and other non-living organic foulants.

COMPATIBLE MEMBRANES

Reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF) membranes.

APPLICATIONS

KOCHKLEEN UC III membrane cleaner is commonly used in food, dairy, beverage and general in-process applications.

ADVANTAGES

Improves Membrane Performance

- Formulated and tested by KMS filtration and chemical experts to provide superior membrane cleaning.
- Quickly penetrates membrane pores to emulsify and suspend contaminants that cause membrane fouling and possible product contamination.
- Compatible with alkaline, acidic, oxygenated and chlorinated KOCHKLEEN membrane cleaners, enabling use over a wide range of membrane filtration applications and operating parameters.

Provides Cost Savings

- Concentrated formula promotes low use cost at recommended levels.
- Automatic dispensing capability ensures accurate dosing and minimizes overuse.
- Multiple use application potential reduces total cleaning product inventories.
- Readily mixes with aqueous solutions to reduce handling and cleaning time.
- Free-rinsing action reduces cleaning cycle time and water use.

Safe to Use

- Suitable for incidental contact with food processing equipment. FDA opinion letter available. Certified kosher pareve.



PHYSICAL PROPERTIES

State: Liquid
Appearance: Pale yellow
Odor: Slight
Solubility: >10% in water

Specific Gravity: 1.055 @ 77 °F (25 °C)
Freezing Point: 41 °F (5 °C)
pH (1% solution): 7
Weight: 8.8 lbs./gallon (1.06 kg/L)

KOCHKLEEN® UC III MEMBRANE CLEANER

USE INSTRUCTIONS

- For typical cleaning-in-place (CIP) applications, use 0.1 – 2.0% (v/v) KOCHKLEEN UC III membrane cleaner.
- Circulate as required and recommended by KMS.
- Always consult the membrane manufacturer for specific procedures.

Refer to your Systems operating Manual or contact KMS Chemicals Group at 800-343-0499, fax at 978-694-7020, for specific cleaning temperatures and times. For precautionary measures and first aid information, refer to the Material Safety Data Sheet (MSDS) or the product label.

KMS PART NUMBERS

KOCHKLEEN® UC III

Bulk Shipment	KPN 3452201
275 gallon (1040 liter)	KPN 2000360-275
55 gallon (208.2 liter)	KPN 3452255
5 gallon (18.9 liter)	KPN 3452205

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

Corporate Headquarters: 850 Main Street, Wilmington, Massachusetts 01887-3388, US, Tel. Toll Free: 1-888-677-5624, Telephone: 1-978-694-7000, Fax: 1-978-657-5208
European Headquarters: Koch Chemical Technology Group Ltd., Units 3-6, Frank Foley Way, Stafford ST16 2ST, GB, Telephone: +44-178-527-2500, Fax: +44-178-522-3149

• San Diego US • Aachen DE • Lyon FR • Madrid ES • Milan IT • Wijnegem BE • Beijing & Shanghai CN • Mumbai & Chennai IN • Melbourne & Sydney AU • Singapore • Sao Paulo BR • Manama BH •

The FLOW LINES DESIGN is a registered trademark of Koch Membrane Systems, Inc. in the US and other countries.

The STYLIZED K is a registered trademark of Koch Industries, Inc. in the US and other countries.

KOCHKLEEN is a registered trademark of Koch Membrane Systems, Inc.

Koch Membrane Systems, Inc. is a Koch Chemical Technology Group, LLC company.

© 2009 Koch Membrane Systems, Inc. All rights reserved worldwide. 10/09



MATERIAL SAFETY DATA SHEET

1 CHEMICAL PRODUCT & COMPANY IDENTIFICATION

TRADE NAME(S) **KOCHKLEEN® UC III**
CAS NUMBER See Below
MSDS NUMBER 14
PRODUCT CODE ND
PRODUCT USE CLEANING AGENT
SYNONYM(S) KOCHKLEEN® ULTRACLEAN III



MANUFACTURER / SUPPLIER Koch Membrane Systems, Inc.
850 Main Street
Wilmington, MA
01887 USA

TELEPHONE NUMBERS - 24 HOUR ASSISTANCE

Canutec: 613-996-6666
Chemtec: 800-424-9300 (inside USA)
+1-703-527-3887 (outside USA)

TELEPHONE NUMBERS - GENERAL ASSISTANCE

(8-5, M-F EST) Product Assistance 978-657-4250

For technical assistance regarding this product, please contact your local Koch Membrane Systems representative.

2 COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient Name	CAS Number	Concentration*	Exposure Limits / Health Hazards
NONYLPHENOL, ETHOXYLATED	9016-45-9	< 100 %	ND
GLYCOL ETHER	NA	< 3 %	ND
ETHYLENE OXIDE	75-21-8	< 10 PPM	1 ppm 8-Hour TWA (OSHA) 5 ppm 15-Min STEL (OSHA) 1 ppm 8-Hour TWA (ACGIH)

*Values do not reflect absolute minimums and maximums; these values are typical which may vary from time to time.

WHMIS Classification: D2B

3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

CAUTION!

HEALTH HAZARDS

MAY BE IRRITATING TO THE SKIN, EYES AND RESPIRATORY TRACT

**SEE "TOXICOLOGICAL INFORMATION" (SECTION 11) FOR MORE INFORMATION

FLAMMABILITY HAZARDS

COMBUSTIBLE AT HIGH TEMPERATURES

REACTIVITY HAZARDS

STABLE

POTENTIAL HEALTH EFFECTS, SKIN

MAY BE IRRITATING.

Repeated or prolonged skin contact may cause reddening, itching and inflammation.

POTENTIAL HEALTH EFFECTS, EYE

MODERATELY TO SEVERELY IRRITATING. Direct contact may cause irritation, redness, tearing and blurred vision.

POTENTIAL HEALTH EFFECTS, INHALATION

Breathing of the mists, vapors or fumes may irritate the nose, throat and lungs. Mists may also cause headache, nausea, and drowsiness.

POTENTIAL HEALTH EFFECTS, INGESTION

Ingestion of large amounts may cause gastrointestinal disturbances. Symptoms may include salivation, pain, nausea, vomiting and diarrhea.

FIRST AID MEASURES

SKIN

Immediately wash skin with plenty of soap and water while removing contaminated clothing and shoes. Get medical attention if irritation develops or persists.

Place contaminated clothing in closed container for storage until laundered or discarded. If clothing is to be laundered, inform person performing operation of contaminant's hazardous properties. Discard contaminated leather goods.

EYE

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

INHALATION

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen.

Get medical attention.

INGESTION

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Never give anything by mouth to an unconscious person. Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis.

Have victim rinse mouth thoroughly with water, then drink 8 to 10 oz. of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have the victim lean forward to reduce risk of aspiration. Repeat administration of water. Quickly transport to emergency care facility.

NOTES TO PHYSICIAN

Gastric lavage may be indicated if ingested. If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

5 FIRE FIGHTING MEASURES

HAZARDOUS COMBUSTION PRODUCTS

Combustion may produce COx, irritating aldehydes and ketones.

EXTINGUISHING MEDIA

Use dry chemical, alcohol foam, all purpose AFFF or carbon dioxide to extinguish fire. Water or foam may cause frothing, with further application leading to boilover.

BASIC FIRE FIGHTING PROCEDURES

Evacuate area and fight fire from a safe distance.

If leak or spill has not ignited, ventilate area and use water spray to disperse gas or vapor and to protect personnel attempting to stop a leak.

Use water spray to cool adjacent structures and to protect personnel. Shut off source of flow if possible. Stay away from storage tank ends. Withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Firefighters must wear MSHA/NIOSH approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

UNUSUAL FIRE & EXPLOSION HAZARDS

May produce a floating fire hazard.

Flash Point	480 °F (237.8 °C) PMCC
Autoignition Temperature	ND
Flammability Limits in Air, Lower, % by Volume	ND
Flammability Limits in Air, Upper, % by Volume	ND

6 ACCIDENTAL RELEASE MEASURES

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind. (See Exposure Controls/Personal Protection in Section 8.)

ENVIRONMENTAL PRECAUTIONS

If product is released to the environment, take immediate steps to stop and contain release. Caution should be exercised regarding personnel safety and exposure to the released product. Notify local, provincial and/or federal authorities, if required.

SPILL OR LEAK PROCEDURE

Keep ignition sources out of area and shut off all ignition sources. Absorb spill with inert material (e. g. dry sand or earth) then place in a chemical waste container. Large Spills: Dike far ahead of liquid spill for later disposal. Stop leak when safe to do so.

Avoid clean up procedures that may result in water pollution.

DO NOT put water directly on leak or spill area. See Exposure Controls/Personal Protection (Section 8).

7 HANDLING & STORAGE

HANDLING

Ground lines and equipment used during transfer to reduce the possibility of static spark-initiated fire or explosion. Use non-sparking tools. Do not cut, grind, drill, weld in the vicinity of the product or reuse containers unless adequate precautions are taken against these hazards.

Do not eat, drink or smoke in areas of use or storage.

STORAGE

Store in tightly closed containers in a cool, dry, isolated, well-ventilated area away from heat, sources of ignition and incompatibles. Avoid contact with strong oxidizers.

Empty containers may contain product residue. Do not reuse without adequate precautions.

Ethylene oxide may collect in container head space. Although concentrations are expected to remain below permissible exposure limits, access and work with open containers and tanks with adequate ventilation.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

General or local exhaust ventilation and other forms of engineering controls are the preferred means for controlling exposures.

EYE PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Wear chemical safety goggles and face shield. Have eye washing facilities readily available where eye contact can occur.

SKIN PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Avoid skin contact with this material.

Provide safety showers at any location where skin contact can occur. Use good personal hygiene.

RESPIRATORY PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Under normal conditions of use, ventilation and engineering controls are sufficient. If irritation is evident, and/or a non-routine or emergency situation, NIOSH/MSHA approved breathing equipment may be required.

9 PHYSICAL & CHEMICAL PROPERTIES

ODOR AND APPEARANCE

PALE YELLOW LIQUID WITH A SLIGHT ODOR

Boiling Point	ND
Specific Gravity	1.06
Melting Point	41 °F (5 °C)
Percent Volatile	ND
Vapor Pressure	< 1 mmHg at 68 °F (20° C)
Vapor Density	> 1
Bulk Density	ND
Solubility in Water	> 10 %
Octanol/Water Partn	ND
pH Value	7
Freezing Point	SEE MELTING POINT
Viscosity	110 at 100 °F (37.7 °C)
Evaporation Rate	ND
Molecular Formula	NA
Molecular Weight	ND
Chemical Family	NONIONIC SURFACTANT
Odor Threshold	ND

10 STABILITY & REACTIVITY

STABILITY/INCOMPATIBILITY

None known. See precautions under Handling & Storage (Section 7).

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS

Combustion may produce COx.

11 TOXICOLOGICAL INFORMATION

ROUTES OF EXPOSURE

Inhalation, ingestion, skin and eye contact.

LD50

ND

LC50

ND

TERATOGENICITY, MUTAGENICITY, OTHER REPRODUCTIVE EFFECTS

Some polyethylene glycol compounds have produced fetal effects in animal studies.

12 ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

ND

13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

This product, as supplied, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261). Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user of the product to determine, at the time of disposal, whether the material is a hazardous waste subject to RCRA.

The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.

In Canada, wastes should be disposed of according to federal, state, provincial and local regulations.

14 TRANSPORT INFORMATION

BILL OF LADING - BULK (U. S. DOT)

Non-Regulated

BILL OF LADING - NON-BULK (U. S. DOT)

Non-Regulated

15 REGULATORY INFORMATION

FEDERAL REGULATIONS

All components of this product are listed on the TSCA Inventory.

This product, as supplied, may contain ethylene oxide, a Hazardous Substance as per 40 CFR Part 302.4. The reportable quantity for ethylene oxide is 10 pound(s). Any release of this product that results in a release of ethylene oxide equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and CFR 355.40, respectively.

Failure to report may result in substantial civil and criminal penalties. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations.

This product contains one or more substances listed as hazardous, toxic or flammable air pollutants under Section 112 of the Clean Air Act.

SARA TITLE III RATINGS

Immediate Hazard:	X	Delayed Hazard:	X	Fire Hazard:	-	Pressure Hazard:	-
Reactivity Hazard:	-						

Following ingredients of this product are listed in SARA313

SARA Listed Ingredient Name	CAS Number	Maximum %
GLYCOL ETHER	NA	3.0

STATE REGULATIONS

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

PENNSYLVANIA - Non-hazardous ingredients present at >3%: None

INTERNATIONAL REGULATIONS

CANADA

All known major components of this product are listed on the Canadian DSL.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and this MSDS contains all the information required by the CPR.

WHMIS Classification: D2B

WHMIS RATINGS

Compressed Gas	-	Flammable/Combustible	-	Oxidizer	-	Acutely Toxic	-
Other Toxic Effects	X	Bio Hazardous	-	Corrosive	-	Dangerously Reactive	-

NFPA RATINGS

Health	1	Flammability	1	Reactivity	0	Special Hazards
--------	---	--------------	---	------------	---	-----------------

HMIS RATINGS * - Indicates chronic health hazard

Health	1*	Flammability	1	Reactivity	0
--------	----	--------------	---	------------	---

OTHER INFORMATION

DISCLAIMER

NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, MSDS may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, expressed or implied, is made as to the accuracy or comprehensiveness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Current Revision Date 03-Aug-2005

Replaces Sheet Dated 19-Jul-2005

Completed By Safety & Emergency Response, Koch Chemical Technology Group, LLC

Appendix F: Process and Cleaning Logs

ECT Bay Harbor Project; Petoskey, MI: FEG Process Data Sheet

Company: _____ Location: _____ # of Passes: _____ # of Modules: _____ Feed Type: _____	Run Description: _____ _____ _____ Date: _____ Page #: _____
--	---

Time	Temp (°F)	Conc Vol (gal)	Conc Factor (X)	Pin (psi)	Pout (psi)	Circ Flow (gpm)	Permeate Flow (/)						Remarks

Notes: (Fax Sheets to Andy Marcinkowski at 978-694-7015)

ECT Bay Harbor Project; Petoskey, MI: Cleaning Data Sheet

Date: _____ UF Unit/Operator: _____	Process Feed: _____ Process Run Description: _____
--	---

Cycle	Time Start/Stop	Chemical	Volume Added	pH	Chemical Concentration	Temp (°F)	Pin / Pout (psig)	Feed Flow (gpm)	Perm Flow (gpm)	Flux (gfd)	Comments
Water Flux											
1											
Water Flux											
2											
Water Flux											
3											
Water Flux											

Notes: (Fax Sheets to Andy Marcinkowski at 978-694-7015) _____

APPENDIX E

Run #: R1
Influent: All 4 (Seep 1, Seep 2, Edge, TLC) - 20 mg/L each alum (Aquamark AQ 120) and metal precipitate (Aquamark AQ 131)
Date: 11/5/2009

Constituent	Abbr.	Unit	Preservative (Sample Handling)	Water Quality Criterion (a) (µg/L, unless otherwise noted)	INFLUENT					PRETREATMENT			UF PERMEATE				
					Seep 1 (S1)	Seep 2W (S2)	Edge	TLC	Combined Influent (CI)	After pH Adjustment (pH)	After Alum Addition (Al)	After Metal Precipitant Addition (MP)	UF 1X	UF 5X	UF 10X	UF 10X Duplicate	Preservative blank
General:																	
Alkalinity	Alk	mg/L	4°C						900						380	390	
Total Organic Carbon	TOC	mg/L	4°C, H ₂ SO ₄ /HCl to pH<2		51	16	160	240	41	42	42	43	14	25	30	30	<1.0
Total Inorganic Carbon	TIC	mg/L			110	67	300	240	100	100	87	88	81	91	90	93	
Total Dissolved Solids	TDS	mg/L	4°C	750 mg/L	7,000	1,800	19,000	16,000	4,800	5,500	5,500	5,700	4,000	5,400	5,500	6,100	
Total Suspended Solids	TSS	mg/L	4°C		5.1	27.5	46.0	6.4	34.8	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	
pH (see Grab Sample Results)	pH	s.u.	None	6.5 - 9.0 s.u.													
Temperature (see Grab Sample Results)	Temp	°C	N/A														
Ammonia Nitrogen (as N)	N	µg/L	4°C, H ₂ SO ₄ to pH<2	29 mg/L													
Total Phosphorus (as P)	P	µg/L	4°C, H ₂ SO ₄ to pH<2	1 mg/L													
Hardness as CaCO ₃		mg/L	HNO ₃ to pH<2		51	160	36	27	116	109	101	101	70	109	128	128	<2
Oxygen Demand:																	
Biochemical Oxygen Demand	BOD ₅	mg/L	4°C	< 20 mg/L					6.2						11	11	
Chemical Oxygen Demand	COD	mg/L	4°C, H ₂ SO ₄ to pH<2						130						89	88	
Total Metals:																	
Aluminum	Al	µg/L	HNO ₃ to pH<2	-	1,600	200	5,200	12,000	1,300	1,200	4,100	4,600	410	690	850	860	<50
Antimony	Sb	µg/L	HNO ₃ to pH<2	2	<1.0	<1.0	1.3	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Arsenic	As	µg/L	HNO ₃ to pH<2	50	26	5.6	130	130	24	26	26	26	15	22	27	26	<1.0
Barium	Ba	µg/L	HNO ₃ to pH<2	580	<10	11	<10	12	10	<10	10	10	20	18	29	28	<10
Beryllium	Be	µg/L	HNO ₃ to pH<2	4.6	<1.0	<1.0	<1.0	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Boron	B	µg/L	HNO ₃ to pH<2	1,900	82	59	160	130	79	85	83	84	81	73	78	80	<10
Cadmium	Cd	µg/L	HNO ₃ to pH<2	2.5	<0.20	<0.20	0.24	0.52	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Chromium, Total	Cr	µg/L	4°C, HNO ₃ to pH<2	92	9.6	<5.0	37	12	6.7	9.4	9.8	9.8	<5.0	5.1	6.6	6.2	<5.0
Cobalt	Co	µg/L	HNO ₃ to pH<2	100													
Copper	Cu	µg/L	HNO ₃ to pH<2	11	21	6.5	100	66	19	21	26	29	<5.0	7.2	9.2	9.1	<5.0
Iron	Fe	µg/L	HNO ₃ to pH<2	-	420	380	560	2,500	400	410	460	480	<20	<20	<20	<20	<20
Lead	Pb	µg/L	HNO ₃ to pH<2	14	1.5	<1.0	11	10	1.7	1.9	2.4	2.6	<1.0	<1.0	<1.0	<1.0	<1.0
Mercury	Hg	µg/L	HNO ₃ to pH<2	0.0013	0.0746	0.0118	0.107	0.465	0.0494	0.0479	0.0470	0.0481	0.0018	0.00246	0.00238	0.00234	<0.000500
Manganese	Mn	µg/L	HNO ₃ to pH<2	2,400	<20	<20	27	38	<20	<20	<20	<20	<20	<20	<20	<20	<20
Molybdenum	Mo	µg/L	HNO ₃ to pH<3	-	100	26	300	260	78	82	82	83	53	78	96	97	<10
Nickel	Ni	µg/L	HNO ₃ to pH<2	65	33	8.9	130	210	29	31	30	32	5.9	11	15	15	<5.0
Selenium	Se	µg/L	HNO ₃ to pH<2	5	24	6.0	78	82	17	22	19	20	15	17	19	16	<1.0
Silicon	(SiO ₂)	µg/L	HNO ₃ to pH<2	-	15,000	6,300	25,000	19,000	11,000	10,000	12,000	12,000	8,400	8,700	8,800	8,800	<500
Silver	Ag	µg/L	HNO ₃ to pH<2	0.20	<0.20	<0.20	<0.20	0.31	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Strontium	Sr	µg/L	HNO ₃ to pH<2	8,300	77	120	<50	<50	110	96	97	100	79	120	130	130	<50
Thallium	Tl	µg/L	HNO ₃ to pH<2	2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium	V	µg/L	HNO ₃ to pH<2	12	35	4.8	140	140	28	30	29	30	22	27	32	32	<4.0
Zinc	Zn	µg/L	HNO ₃ to pH<2	150	<20	<20	220	150	30	52	66	57	<20	20	21	<20	<20
Alkali Cations:																	
Calcium	Ca ²⁺	µg/L	4°C		16,000	37,000	13,000	7,700	31,000	27,000	25,000	26,000	17,000	27,000	32,000	32,000	<500
Magnesium	Mg ²⁺	µg/L	4°C		4,400	18,000	2,600	<500	12,000	11,000	11,000	11,000	7,700	11,000	13,000	13,000	<500
Potassium	K ⁺	µg/L	4°C		3,100,000	760,000	8,000,000	7,300,000	2,400,000	2,200,000	2,300,000	2,300,000	1,800,000	2,300,000	2,500,000	2,500,000	<500
Sodium	Na ⁺	µg/L	4°C		220,000	78,000	510,000	490,000	170,000	160,000	170,000	170,000	130,000	170,000	180,000	180,000	<500
Anions:		µg/L															
Bromide	Br ⁻	mg/L	4°C		16	2.0	37	48	11	11	11	12	11	14	14	12	
Chloride	Cl ⁻	mg/L	4°C	50 mg/L	440	130	1,100	810	400	330	330	330	330	320	310	310	
Fluoride	F ⁻	mg/L	4°C		6.4	0.88	41	15	4	4.9	3.5	4.0	4.1	4.0	3.5	7.5	
Sulfate	SO ₄ ²⁻	mg/L	4°C		2,300	650	7,200	5,600	2,200	2,300	2,400	2,400	1,700	2,400	2,700	2,700	

(a) WATER QUALITY STANDARDS FOR RECEIVING WATER BODY.

Sludge (UF Concentrate) Analytical

Date: 11/5/09

[illegible]

Run #: R1

Influent: All 4 (Seep 1, Seep 2, Edge, TLC) - 20 mg/L each alum (Aquamar AQ 120) and metal precipitate (Aquamar AQ 131)

Date: 11/5/2009

INFLUENT

GRAB SAMPLE - 1

Seep 1			Seep 2W			Edge			TLC			COMBINED INFLUENT (CI)		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/5/09	10:50		11/5/09	10:35		11/5/09	10:39		11/5/09	10:55		11/5/09	11:15	
		12.24			9.67			11.62			12.53			11.91
		11.8			17.1			18.5			17.8			14
		1,000			2,900			9,170			9,200			7,600

Sample Collection Date/Time:

pH:

Temperature (°C):

Specific Conductance (umhos @ 25°C)

PRETREATMENT

GRAB SAMPLE - 1

After pH Adjustment (pH)			After Alum Addition (Al)			After Metal Percipitant Addition		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/5/09	12:30		11/5/09	11:25		11/5/09	11:35	
		7.8			8.17			8.43
		15.5			15.3			15.6
		7,300			7,500			7,400

Sample Collection Date/Time:

pH:

Temperature (°C):

Dissolved Oxygen (O₂):

Specific Conductance (umhos @ 25°C)

Flow (gpm):

UF PERMEATE

GRAB SAMPLE - 1

UF 1X			UF 5X			UF 10X			UF FX		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/5/09						11/5/09					
		7.71						7.93			
								28.9			
								5.2			
								8.4			

Sample Collection Date/Time:

pH:

Temperature (°C):

Dissolved Oxygen (O₂):

Specific Conductance (umhos @ 25°C)

Flow (gpm):

Run #: R2
Influent: All 4 (Seep 1, Seep 2, Edge, TLC) - 50 mg/L each alum (Aquamar AQ 120) and metal precipitate (Aquamar AQ 131)
Date: 11/9/2009

Constituent	Abbr.	Unit	Preservative (Sample Handling)	Water Quality Criterion (a) (µg/L, unless otherwise noted)	INFLUENT					PRETREATMENT			UF PERMEATE				
					Seep 1 (S1)	Seep 2W (S2)	Edge	TLC	Combined Influent (CI)	After pH Adjustme nt (pH)	After Alum Addition (Al)	After Metal Precipitant Addition (MP)	UF 1X	UF 5X	UF 10X	UF 10X Duplicate	UF 30 X
General:																	
Alkalinity	Alk	mg/L	4°C						890						430	440	
Total Organic Carbon	TOC	mg/L	4°C, H ₂ SO ₄ /HCl to pH<2						40						36	37	
Total Inorganic Carbon	TIC	mg/L							100						110	100	
Total Dissolved Solids	TDS	mg/L	4°C	750 mg/L	7,300	1,700	21,000	16,000	5,100	5,200			4,600	5,600	6,000	5,600	7,200
Total Suspended Solids	TSS	mg/L	4°C		4.1	22.1	6.4	<3.3	26.1	31.0			<3.3	<3.3	8.7	4.8	6.1
pH (see Grab Sample Results)	pH	s.u.	None	6.5 - 9.0 s.u.													
Temperature (see Grab Sample Results)	Temp	°C	N/A														
Ammonia Nitrogen (as N)	N	µg/L	4°C, H ₂ SO ₄ to pH<2	29 mg/L													
Total Phosphorus (as P)	P	µg/L	4°C, H ₂ SO ₄ to pH<2	1 mg/L													
Hardness as CaCO ₃		mg/L	HNO ₃ to pH<2						86						109	107	
Oxygen Demand:																	
Biochemical Oxygen Demand	BOD ₅	mg/L	4°C	< 20 mg/L					5.1						14	13	
Chemical Oxygen Demand	COD	mg/L	4°C, H ₂ SO ₄ to pH<2						140						120	120	
Total Metals:																	
Aluminum	Alk	µg/L	HNO ₃ to pH<2	-					1,200						820	810	
Antimony	Sb	µg/L	HNO ₃ to pH<2	2					<1.0						<1.0	<1.0	
Arsenic	As	µg/L	HNO ₃ to pH<2	50					22						26	25	
Barium	Ba	µg/L	HNO ₃ to pH<2	580					12						31	31	
Beryllium	Be	µg/L	HNO ₃ to pH<2	4.6					<1.0						<1.0	<1.0	
Boron	B	µg/L	HNO ₃ to pH<2	1,900					80						86	81	
Cadmium	Cd	µg/L	HNO ₃ to pH<2	2.5					<0.20						<0.20	<0.20	
Chromium, Total	Cr	µg/L	4°C, HNO ₃ to pH<2	92					5.9						5.3	5.5	
Cobalt	Co	µg/L	HNO ₃ to pH<2	100													
Copper	Cu	µg/L	HNO ₃ to pH<2	11					19						7.2	7.4	
Iron	Fe	µg/L	HNO ₃ to pH<2	-					450						<20	<20	
Lead	Pb	µg/L	HNO3 to pH<2	14					1.5						<1.0	<1.0	
Mercury	Hg	µg/L	HNO3 to pH<2	0.0013	0.0884	0.0144	0.122	0.402	0.0469	0.0450			0.00308	0.00307	0.00432	0.00430	0.00391
Manganese	Mn	µg/L	HNO3 to pH<2	2,400					<20						<20	<20	
Molybdenum	Mo	µg/L	HNO3 to pH<3						76						99	99	
Nickel	Ni	µg/L	HNO3 to pH<2	65					26						18	18	
Selenium	Se	µg/L	HNO3 to pH<2	5					16						14	14	
Silicon	(SiO2)	µg/L	HNO3 to pH<2	-					10,000						6,200	4,200	
Silver	Ag	µg/L	HNO3 to pH<2	0.20					<0.20						<0.20	<0.20	
Strontium	Sr	µg/L	HNO3 to pH<2	8,300					83						110	110	
Thallium	Tl	µg/L	HNO3 to pH<2	2					<1.0						<1.0	<1.0	
Vanadium	V	µg/L	HNO3 to pH<2	12	34	5.9	140	100	26	24			22	28	31	32	34
Zinc	Zn	µg/L	HNO3 to pH<2	150					44						27	<20	
Alkali Cations:																	
Calcium	Ca ²⁺	µg/L	4°C						21,000						27,000	27,000	
Magnesium	Mg ²⁺	µg/L	4°C						9,700						11,000	11,000	
Potassium	K ⁺	µg/L	4°C		3,200,000	720,000	9,300,000	6,700,000	2,200,000	2,000,000			2,000,000	2,300,000	2,600,000	2,500,000	2,700,000
Sodium	Na ⁺	µg/L	4°C						160,000						190,000	180,000	
Anions:		µg/L															
Bromide	Br ⁻	mg/L	4°C						10						16	13	
Chloride	Cl ⁻	mg/L	4°C	50 mg/L	470	130	1,200	800	330	310			320	360	330	320	330
Fluoride	Fl ⁻	mg/L	4°C						6.4						5.4	4.9	
Sulfate	SO ₄ ²⁻	mg/L	4°C		2,400	610	7,700	5,400	1,700	2,100			2,000	2,600	2,800	2,700	3,300

(a) WATER QUALITY STANDARDS FOR RECEIVING WATER BODY.

CMS Bay Harbor Development
Pilot Treatment Study
Sludge (UF Concentrate) Analytical

Run #: R2

Influent: All 4 (Seep 1, Seep 2, Edge, TLC) - 50 mg/L each alum (Aquamark AQ 120) and metal precipitate (Aquamark AQ 131)

Date: 11/9/09

[illegible]

CMS Bay Harbor Development
Pilot Treatment Plant Study
Water Quality Data - Field

Run #: R2

Influent: All 4 (Seep 1, Seep 2, Edge, TLC) - 50 mg/L each alum (Aquamar AQ 120) and metal precipitate (Aquamar AQ 131)

Date: 11/9/09

INFLUENT

GRAB SAMPLE - 1

Seep 1			Seep 2W			Edge			TLC			COMBINED INFLUENT (CI)		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/9/09	11:50		11/9/09	12:05		11/9/09	12:10		11/9/09	12:20		11/9/09	11:30	
Sample Collection Date/Time:														
pH:		12.2			10.2			12.72			12.37			11.47
Temperature (°C):		13.8			11.2			12.2			19.4			17.1
Specific Conductance (milisimons):		11.3			2.7			>20			>20			7.6

PRETREATMENT

GRAB SAMPLE - 1

After pH Adjustment (pH)			After Alum Addition (Al)			After Metal Percipitant Addition		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
						11/9/09	10:40	
Sample Collection Date/Time:								
pH:								8.35
Temperature (°C):								18.9
Dissolved Oxygen (O ₂):								
Specific Conductance (umhos @ 25°C):								6.9
Flow (gpm):								

UF PERMEATE

GRAB SAMPLE - 1

UF 1X			UF 5X			UF 10X			UF FX - 30X		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/9/09	14:10		11/9/09	17:10		11/9/09	18:00		11/9/09	18:40	
Sample Collection Date/Time:											
pH:		8.21			8.19			8.15			8.13
Temperature (°C):		21.1			28.7			31.8			27.7
Dissolved Oxygen (O ₂):								4.84			
Specific Conductance (umhos @ 25°C):		6.6			7.8			8.6			9.1
Flow (gpm):											

Run #: R3

Influent: All 4 (Seep 1, Seep 2, Edge, TLC) - 50 mg/L each alum (Aquamar AQ 120) and metal precipitate (Aquamar AQ 131)

Date: 11/10/09

Constituent	Abbr.	Unit	Preservative (Sample Handling)	Water Quality Criterion (a) (µg/L, unless otherwise noted)	INFLUENT					PRETREATMENT			UF PERMEATE				
					Seep 1 (S1)	Seep 2W (S2)	Edge	TLC	Combined Influent (CI)	After pH Adjustmen t (pH)	After Alum Addition (Al)	After Metal Precipitant Addition (MP)	UF 1X	UF 5X	UF 10X	UF 10X Duplicate	UF 20X
General:																	
Alkalinity	Alk	mg/L	4°C						1,200						430	430	
Total Organic Carbon	TOC	mg/L	4°C, H ₂ SO ₄ /HCl to pH<2						61						43	44	
Total Inorganic Carbon	TIC	mg/L							120						97	97	
Total Dissolved Solids	TDS	mg/L	4°C	750 mg/L	8,100	2,000	20,000	15,000	6,700	6,500			4,800	6,000	6,200	6,400	7,740
Total Suspended Solids	TSS	mg/L	4°C		19.7	10.3	23.1	14.4	13.2	8.3			5.7	4.4	8.5	8.3	5.5
pH (see Grab Sample Results)	pH	s.u.	None	6.5 - 9.0 s.u.													
Temperature (see Grab Sample Results)	Temp	°C	N/A														
Ammonia Nitrogen (as N)	N	µg/L	4°C, H ₂ SO ₄ to pH<2	29 mg/L													
Total Phosphorus (as P)	P	µg/L	4°C, H ₂ SO ₄ to pH<2	1 mg/L													
Hardness as CaCO ₃		mg/L	HNO ₃ to pH<2						95						112	112	
Oxygen Demand:																	
Biochemical Oxygen Demand	BOD ₅	mg/L	4°C	< 20 mg/L					16						13	14	
Chemical Oxygen Demand	COD	mg/L	4°C, H ₂ SO ₄ to pH<2						200						130	130	
Total Metals:																	
Aluminum	Alk	µg/L	HNO ₃ to pH<2	-					1,800						700	690	
Antimony	Sb	µg/L	HNO ₃ to pH<2	2					<1.0						<1.0	<1.0	
Arsenic	As	µg/L	HNO ₃ to pH<2	50					33						30	28	
Barium	Ba	µg/L	HNO ₃ to pH<2	580					13						48	49	
Beryllium	Be	µg/L	HNO ₃ to pH<2	4.6					<1.0						<1.0	<1.0	
Boron	B	µg/L	HNO ₃ to pH<2	1,900					92						88	90	
Cadmium	Cd	µg/L	HNO ₃ to pH<2	2.5					<0.20						<0.20	<0.20	
Chromium, Total	Cr	µg/L	4°C, HNO ₃ to pH<2	92					8.3						5.5	5.4	
Cobalt	Co	µg/L	HNO ₃ to pH<2	100													
Copper	Cu	µg/L	HNO ₃ to pH<2	11					34						14	14	
Iron	Fe	µg/L	HNO ₃ to pH<2	-					490						30	29	
Lead	Pb	µg/L	HNO3 to pH<2	14					2.2						<1.0	<1.0	
Mercury	Hg	µg/L	HNO3 to pH<2	0.0013	0.0668	0.00801	0.0927	0.241	0.0424	0.0384			0.00175	0.00278	0.00476	0.00491	0.00382
Manganese	Mn	µg/L	HNO3 to pH<2	2,400					<20						<20	<20	
Molybdenum	Mo	µg/L	HNO3 to pH<3						100						110	110	
Nickel	Ni	µg/L	HNO3 to pH<2	65					41						24	25	
Selenium	Se	µg/L	HNO3 to pH<2	5					21						19	17	
Silicon	(SiO2)	µg/L	HNO3 to pH<2	-					8,800						6,500	3,000	
Silver	Ag	µg/L	HNO3 to pH<2	0.20					<0.20						<0.20	<0.20	
Strontium	Sr	µg/L	HNO3 to pH<2	8,300					89						110	110	
Thallium	Tl	µg/L	HNO3 to pH<2	2					<1.0						<1.0	<1.0	
Vanadium	V	µg/L	HNO3 to pH<2	12	42	5.7	130	110	38	30			23	33	35	33	42
Zinc	Zn	µg/L	HNO3 to pH<2	150					58						24	26	
Alkali Cations:																	
Calcium	Ca ²⁺	µg/L	4°C						21,000						27,000	27,000	
Magnesium	Mg ²⁺	µg/L	4°C						9,900						12,000	12,000	
Potassium	K ⁺	µg/L	4°C		3,400,000	1,000,000	7,200,000	6,300,000	2,800,000	2,500,000			2,100,000	2,700,000	2,900,000	2,900,000	3,100,000
Sodium	Na ⁺	µg/L	4°C						200,000						210,000	210,000	
Anions:		µg/L															
Bromide	Br ⁻	mg/L	4°C						18						19	19	
Chloride	Cl ⁻	mg/L	4°C	50 mg/L	510	190	1,100	750	400	330			370	360	360	360	350
Fluoride	F ⁻	mg/L	4°C						4.8						3.8	3.7	
Sulfate	SO ₄ ²⁻	mg/L	4°C		2,700	950	6,800	5,000	2,300	2,500			2,200	2,900	3,100	3,100	3,400

(a) WATER QUALITY STANDARDS FOR RECEIVING WATER BODY.

Run #: R3

Influent : All 4 (Seep 1, Seep 2, Edge, TLC) - 20 mg/L each alum (Aquamark AQ 120) and metal precipitate (Aquamark AQ 131)

Date: 11/10/09

INFLUENT

GRAB SAMPLE - 1

Seep 1			Seep 2W			Edge			TLC			COMBINED INFLUENT (CI)		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/10/09	12:40		11/10/09	12:55		11/10/09	12:25		11/10/09	12:10		11/10/09	11:55	
pH:		12.43			9.69			12.37			12.21			11.8
Temperature (°C):		12.6			11.2			17.5			18.6			14.4
Specific Conductance (umhos @ 25°C):		12.6			3.9			>20			>20			8.4

PRETREATMENT

GRAB SAMPLE - 1

After pH Adjustment (pH)			After Alum Addition (Al)			After Metal Percipitant Addition		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/10/09			11/10/09			11/10/09	7:45	
pH:								8.55
Temperature (°C):								14.4
Dissolved Oxygen (O ₂):								
Specific Conductance (umhos @ 25°C):								8.2
Flow (gpm):								

UF PERMEATE

GRAB SAMPLE - 1

UF 1X			UF 5X			UF 10X			UF FX		
DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE	DATE	TIME	VALUE
11/10/09	13:40		11/10/09	16:50		11/10/09	17:25		11/10/09	17:40	
pH:		8.54			8.39			8.34			8.26
Temperature (°C):		16.8			25.7			28.8			31
Dissolved Oxygen (O ₂):								5.03			
Specific Conductance (umhos @ 25°C):		7			8.8			9.2			9.8
Flow (gpm):											

CMS Bay Harbor Development
Section III.B.10
WET Test Results

Preliminary Acute Toxicity Test Results for the ECT Water Samples Collected from Bay Harbor on November 5, 10, 17, and, 19, 2009

Sample ID GLC Number Date Collected	Test Organism and Test Duration	Test Concentrations Percent (%) Mortality at Test Completion						Test Results	
		Con	6.25%	12.5%	25%	50%	100%	LC ₅₀	TU _a
BH Pilot R1 GLC# 7940 November 05, 2009	<i>C. dubia</i> - 48Hour	0	20	100	100	100	100	8.11	12.3
	FHM-96-Hour	0	0	0	50	100	100	25.0	4.0
R3 UF 10x GLC# 7942 November 10, 2009	<i>C. dubia</i> - 48Hour	0	25	95	100	100	100	8.01	12.5
	FHM-96-Hour	5	5	0	100	100	100	17.5	5.7

APPENDIX F



KOCHKLEEN[®] 100 MEMBRANE CLEANER

Liquid, Acidic Membrane Cleaner for Low pH Cleaning

DESCRIPTION

KOCHKLEEN 100 membrane cleaner is a concentrated, proprietary blend of inorganic acids specifically formulated for superior low pH cleaning of membrane filtration systems.

COMPATIBLE MEMBRANES

Reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF).

APPLICATIONS

KOCHKLEEN 100 membrane cleaner is commonly used in food, dairy, pharmaceutical, industrial wastewater and general in-process applications.

ADVANTAGES

Improves membrane performance

- Formulated and tested by KMS filtration and chemical experts to provide superior membrane cleaning.
- Rapidly removes inorganic scale.
- Compatible with acid-resistant membranes.

Provides cost savings

- Concentrated formula promotes low use cost at recommended levels.
- Dispensable liquid mixes readily with water to reduce handling, mixing and cleaning time.
- Free-rinsing action. Surfactant-free formulation reduces cleaning cycle time and water use.

Safe to Use

- Suitable for incidental contact with food processing equipment. FDA opinion letter available.
- Compatible with 304 and 316 stainless steel, carbon steel, PVC, CPVC, EPDM and Viton[®] materials of construction.

PHYSICAL PROPERTIES

State: Liquid
Appearance: Clear
Odor: Nitric Acid
Solubility: Complete in water
@ 68 °F (20 °C)

Specific Gravity: 1.35 @ 68 °F (20 °C)
Freezing Point: ND
pH (1% solution): 1.3 – 1.9
Weight: 11.2 lbs/gallon (1.34 kg/L)

KOCHKLEEN® 100 MEMBRANE CLEANER

USE INSTRUCTIONS

- For typical cleaning-in-place (CIP), adjust pH to 1.8 – 2.0.
- Typical usage of KOCHKLEEN 100 membrane cleaner is 0.2 – 0.3% (v/v).
- NEVER use KOCHKLEEN 100 membrane cleaner for manual cleaning.
- Only use KOCHKLEEN 100 membrane cleaner in stainless steel equipment and piping which is equipped with acid-resistant pumps.
- Circulate final solution as required and recommended by KMS.
- Always consult the membrane manufacturer for specific procedures.

Refer to your Systems operating Manual or contact KMS Chemicals Group at 800-343-0499, fax at 978-694-7020, for specific cleaning temperatures and times. For precautionary measures and first aid information, refer to the Material Safety Data Sheet (MSDS) or the product label.

KMS PART NUMBERS

KOCHKLEEN® 100
KOCHKLEEN® 100

5 gallon (18.9 liter)
55 gallon (208.2 liter)

KPN 3410005
KPN 3410055

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

USA: 850 Main Street, Wilmington, MA 01887-3388, Telephone: 800-343-0499, Telephone: 978-657-4250, Fax: 978-657-5208

USA: 10054 Old Grove Road, San Diego, CA 92131, Telephone: 800-525-4369, Telephone: 858-695-3840, Fax 858-695-2176

UK: The Granary, Telegraph Street, Stafford, ST17 4AT, Telephone: +44-1785-272500, Fax: +44-1785-223149

AUSTRALIA: Suite 6, Level 1, 186-190 Church Street, Parramatta, NSW 2150, Tel: +61 2 8833 4640, Fax: +61 2 9689 3615

Viton® is a registered trademark of DuPont Dow Elastomers, LLC

KOCHKLEEN® is a registered trademark of Koch Membrane Systems, Inc.

Koch Membrane Systems, Inc. is a member of Koch Chemical Technology Group, LLC.

© 2004 Koch Membrane Systems, Inc. All rights reserved worldwide. 06/04



MATERIAL SAFETY DATA SHEET

1 CHEMICAL PRODUCT & COMPANY IDENTIFICATION

TRADE NAME(S) KOCHKLEEN® 100
CAS NUMBER MIXTURE
MSDS NUMBER 5705
PRODUCT CODE ND
SYNONYM(S) ND



MANUFACTURER / SUPPLIER Koch Membrane Systems, Inc.
850 Main Street
Wilmington, MA
01887 USA

TELEPHONE NUMBERS - 24 HOUR ASSISTANCE

Canutec: 613-996-6666

Chemtec: 800-424-9300

TELEPHONE NUMBERS - GENERAL ASSISTANCE

(8-5, M-F EST) Product 978-657-4250

Assistance

For technical assistance regarding this product, please contact your local Koch Membrane Systems representative.

2 COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient Name	CAS Number	Concentration*	Exposure Limits / Health Hazards
PHOSPHORIC ACID	7664-38-2	15 - 30 %	1 mg/m3 8-Hour TWA (OSHA) 1 mg/m3 8-Hour TWA (ACGIH) 3 mg/m3 15-Min STEL (ACGIH)
NITRIC ACID	7697-37-2	15 - 30 %	2 ppm 8-Hour TWA (OSHA) 2 ppm 8-Hour TWA (ACGIH) 4 ppm 15-Min STEL (ACGIH)

*Values do not reflect absolute minimums and maximums; these values are typical which may vary from time to time.

WHMIS Classification: E.

3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER!

HEALTH HAZARDS

CORROSIVE TO EYES AND SKIN.

MAY CAUSE BLINDNESS

HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.

ASPIRATION HAZARD IF SWALLOWED-CAN ENTER LUNGS AND CAUSE DAMAGE

**SEE "TOXICOLOGICAL INFORMATION" (SECTION 11) FOR MORE INFORMATION

FLAMMABILITY HAZARDS

NON-COMBUSTIBLE

REACTIVITY HAZARDS

STABLE

POTENTIAL HEALTH EFFECTS, SKIN

CORROSIVE. Contact may cause reddening, itching, inflammation, burns, blistering and possibly severe tissue damage.

POTENTIAL HEALTH EFFECTS, EYE

CORROSIVE. Exposure may cause severe burns, destruction of eye tissue and possible permanent injury or blindness.

POTENTIAL HEALTH EFFECTS, INHALATION

EXTREMELY IRRITATING AND CORROSIVE. Fumes or vapors from the heated material may be severely irritating and corrosive. Symptoms may include throat burns, constriction of the windpipe (bronchospasms), severe pulmonary edema and death, depending on the concentration and duration of exposure. Symptoms may include sore throat, coughing, labored breathing, sneezing and burning sensation, depending on the concentration and duration of exposure.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

Other specific symptoms of exposure are listed under "Toxicological Information" (Section 11).

POTENTIAL HEALTH EFFECTS, INGESTION

CORROSIVE. May cause painful irritation and burning of the mouth and throat, painful swallowing, labored breathing, burns or perforation of the gastrointestinal tract leading to ulceration and secondary infection. Symptoms may include salivation, pain, nausea, vomiting and diarrhea.

Aspiration into lungs may cause chemical pneumonia and lung damage.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

Other specific symptoms of exposure are listed under "Toxicological Information" (Section 11).

4 FIRST AID MEASURES

SKIN

Immediately flush skin with plenty of water, for at least 15 minutes, while removing contaminated clothing and shoes. GET IMMEDIATE MEDICAL ATTENTION.

Place contaminated clothing in closed container for storage until laundered or discarded. If clothing is to be laundered, inform person performing operation of contaminant's hazardous properties. Discard contaminated leather goods.

EYE

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

INHALATION

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen.

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

INGESTION

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Never give anything by mouth to an unconscious person. Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis.

Have victim rinse mouth thoroughly with water, then drink 8 to 10 oz. of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have the victim lean forward to reduce risk of aspiration. Repeat administration of water. Quickly transport to emergency care facility.

NOTES TO PHYSICIAN

This product is primarily an irritant and corrosive. As a corrosive, give attention to potential complication of esophagus or stomach perforations if ingested. Use of emetics and lavage are contraindicated. Necrosis and associated inflammatory processes peak at about 48 hours, but may extend up to four days. Initial healing processes occur during the period 4 to 14 days, but the esophageal wall is weakest during this period. Signs and symptoms of CNS depression, confusion and convulsions should be considered in the assessment and treatment of victims of exposures.

If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

5 FIRE FIGHTING MEASURES

HAZARDOUS COMBUSTION PRODUCTS

Combustion may produce NOx, POx, acid fumes, nitrogen peroxide and hydrogen nitrate.

EXTINGUISHING MEDIA

Material itself will not burn.

BASIC FIRE FIGHTING PROCEDURES

Do not add water to acid. Water applied directly results in evolution of heat and splattering of acid. Acid can react with metals to liberate flammable hydrogen gas, especially when diluted with water. Evacuate area and fight fire from a safe distance. Use extinguishing agent suitable for type of surrounding fire.

Use water spray to cool adjacent structures and to protect personnel. Do not get water inside KOCHKLEEN® 100 containers. Shut off source of flow if possible. Stay away from storage tank ends. Withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Firefighters must wear MSHA/NIOSH approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

UNUSUAL FIRE & EXPLOSION HAZARDS

Material will not burn.

May have hazardous or explosive reactions with metallic powders, carbides or sulfides.

Flash Point	NA (WATER BASE)
Autoignition Temperature	ND
Flammability Limits in Air, Lower, % by Volume	ND
Flammability Limits in Air, Upper, % by Volume	ND

6 ACCIDENTAL RELEASE MEASURES

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. Evacuate area endangered by release as required. (See Exposure Control/Personal Protection - Section 8).

ENVIRONMENTAL PRECAUTIONS

If product is released to the environment, take immediate steps to stop and contain release. Caution should be exercised regarding personnel safety and exposure to the released product. Notify local, provincial and/or federal authorities, if required.

SPILL OR LEAK PROCEDURE

Keep unnecessary people away. Isolate area for at least 25-50 meters (80-160 feet) to preserve public safety. For large spills, consider initial evacuation for at least 300 meters (1000 feet).

Large spills may be neutralized with dilute alkaline solutions of soda ash or lime. Stop leak when safe to do so.

Do not touch or walk through spilled material.

See Exposure Controls/Personal Protection (Section 8).

7 HANDLING & STORAGE

HANDLING

This material should be stored and shipped in plastic or plastic lined containers. Do not use with materials or equipment sensitive to acidic solutions.

Do not eat, drink or smoke in areas of use or storage.

STORAGE

Avoid contact with strong oxidizers, bases, chlorine releasers and metals. Store in tightly closed containers in cool, dry area away from heat and incompatibles.

Empty containers may contain product residue. Do not reuse without adequate precautions.

Ship or store only in containers that meet the specifications for corrosives, packing group I.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

General or local exhaust ventilation and other forms of engineering controls are the preferred means for controlling exposures.

EYE PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Wear chemical safety goggles and face shield. Have eye washing facilities readily available where eye contact can occur.

SKIN PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Avoid skin contact with this material. If skin contact is anticipated, protective clothing, including impervious gloves, should be worn.

Additional protection may be necessary to prevent skin contact including use of apron, armcovers, face shield, or boots. Provide safety showers at any location where skin contact can occur.

Use good personal hygiene.

RESPIRATORY PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

A NIOSH/MSHA approved air purifying respirator with an acid vapor cartridge or canister may be appropriate under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

9 PHYSICAL & CHEMICAL PROPERTIES

ODOR AND APPEARANCE

CLEAR, COLORLESS LIQUID WITH AN ACIDIC ODOR

Boiling Point	212 °F (100 °C)
Specific Gravity	1.4
Melting Point	NA
Percent Volatile	50 - 70 %
Vapor Pressure	ND
Vapor Density	2 - 3 (NITRIC ACID); 3.4 (PHOSPHORIC ACID)
Bulk Density	10.51 LBS/GAL
Solubility in Water	100 %
Octanol/Water Partn	ND
Volatile Organic	NA
Pour Point	NA
pH Value	< 1
Freezing Point	ND
Viscosity	ND
Evaporation Rate	ND
Molecular Formula	NA
Molecular Weight	ND
Chemical Family	MINERAL ACID
Odor Threshold	0.75 mg/m3 (NITRIC ACID)

10 STABILITY & REACTIVITY

STABILITY/INCOMPATIBILITY

Incompatible with bases and chlorine releasers. Avoid contact with metals. See precautions under Handling & Storage (Section 7).

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS

Combustion may produce NO_x, PO_x, acid fumes, nitrogen peroxide and hydrogen nitrate.

11 TOXICOLOGICAL INFORMATION

ROUTES OF EXPOSURE

Inhalation, ingestion, skin and eye contact.

LD50

ND

TOXICOLOGICAL DATA

Acute or chronic overexposure to this material or its components may cause systemic toxicity, including adverse effects to the following: skin, eye, teeth, blood and respiratory system.

Exposure to components of this material may cause the following specific symptoms, depending on the concentration and duration of exposure: chronic obstructive pulmonary disease, erosion of teeth and chest pains. Other symptoms of exposure may include the following: cardiovascular collapse, acidosis, bloody diarrhea, bloody vomit and shock.

PRE-EXISTING CONDITIONS AGGRAVATED BY EXPOSURE

Pre-existing medical conditions which may be aggravated by exposure include disorders of the skin, eye respiratory and cardiovascular systems.

12 ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

ND

13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

This product, as supplied, when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR 261) due to its corrosivity.. Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user of the product to determine, at the time of disposal, whether the material is a hazardous waste subject to RCRA.

The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.

In Canada, wastes should be disposed of according to federal, state, provincial and local regulations.

14 TRANSPORT INFORMATION

BILL OF LADING - BULK (U. S. DOT)

Corrosive Liquid, Acidic, Inorganic, N.O.S. (Nitric Acid, Phosphoric Acid), 8, UN3264, PG I

BILL OF LADING - NON-BULK (U. S. DOT)

Corrosive Liquid, Acidic, Inorganic, N.O.S. (Nitric Acid, Phosphoric Acid), 8, UN3264, PG I

The above description may not cover shipping in all cases, please consult 49 CFR 172.101 for specific shipping information.

15 REGULATORY INFORMATION

FEDERAL REGULATIONS

All components of this product are listed on the TSCA Inventory.

This product, as supplied, contains phosphoric acid, a Hazardous Substance as per 40 CFR Part 302.4. The reportable quantity for phosphoric acid is 5000 pound(s). Any release of this product that results in a release of phosphoric acid equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and 40 CFR 355.40, respectively.

This product, as supplied, contains nitric acid, a Hazardous Substance as per 40 CFR Part 302.4 and an Extremely Hazardous Substance as per 40 CFR Part 355. The reportable quantity for nitric acid is 1000 pounds. Any release of this product equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and 40 CFR 355.40, respectively. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Failure to report may result in substantial civil and criminal penalties.

This product contains nitric acid which is listed as an extremely hazardous substance and is subject to the notification and inventory reporting requirements of the Superfund Amendments and Reauthorization Act (SARA) Section 302 (40 CFR 355) and Section 311/312, respectively.

This product contains one or more components designated as hazardous substances or toxic pollutants pursuant to the Federal Clean Water Act (40 CFR 116.4 Table A; 40 CFR 401.15). Any unpermitted introduction of this product into a facility stormwater or wastewater discharge may constitute a violation of the Clean Water Act. Facilities must notify the appropriate permitting agency prior to introducing this product into the aforementioned discharges.

There may be specific regulations at the local, regional or state/provincial level that pertain to this product.

SARA TITLE III RATINGS

Immediate Hazard:	X	Delayed Hazard:	-	Fire Hazard:	-	Pressure Hazard:	-
Reactivity Hazard:	-						

Following ingredients of this product are listed in SARA313

SARA Listed Ingredient Name	CAS Number	Maximum %
NITRIC ACID	7697-37-2	30.0

STATE REGULATIONS

Based on available information this product does not contain any components or chemicals currently known to the State of California to cause cancer, birth defects or reproductive harm at levels which would be subject to Proposition 65. Reformulation, use or processing of this product may affect its composition and require re-evaluation.

PENNSYLVANIA - Non-hazardous ingredients present at >3%: Water, CAS # 7732-18-5

INTERNATIONAL REGULATIONS

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and this MSDS contains all the information required by the CPR.

WHMIS Classification: E.

All known major components of this product are listed on the Canadian DSL.

WHMIS RATINGS

Compressed Gas	Flammable/Combustible	Oxidizer		Acutely Toxic
Other Toxic Effects	Bio Hazardous	Corrosive	X	Dangerously Reactive

NFPA RATINGS

Health	3	Flammability	0	Reactivity	0	Special Hazards
--------	---	--------------	---	------------	---	-----------------

HMIS RATINGS

Health	3	Flammability	0	Reactivity	0
--------	---	--------------	---	------------	---

OTHER INFORMATION**DISCLAIMER**

NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, MSDS may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, expressed or implied, is made as to the accuracy or comprehensiveness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Current Revision Date 07-Apr-2005

Replaces Sheet Dated 07-Apr-2005

Completed By Safety & Emergency Response, Koch Chemical Technology Group, LLC



KOCHKLEEN[®] 222 MEMBRANE CLEANER

Liquid, Alkaline Membrane Cleaner - Chlorine-Free and EDTA-Free Formula

DESCRIPTION

KOCHKLEEN 222 membrane cleaner is a specially formulated, chlorine-free and EDTA-free, alkaline membrane cleaner.

COMPATIBLE MEMBRANES

Reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF) membranes.

APPLICATIONS

KOCHKLEEN 222 membrane cleaner is commonly used in food, dairy, beverage, pharmaceutical, industrial wastewater and general in-process applications.

ADVANTAGES

Improves Membrane Performance

- Formulated and tested by KMS filtration and chemical experts to provide superior membrane cleaning.
- Improves membrane performance and maximizes production capabilities by loosening, dissolving and effectively removing the membrane fouling layer.
- Removes fats, proteins and inorganic foulants.

Provides Cost Savings

- Concentrated formula promotes low use cost at recommended levels.
- Dispensable liquid that readily mixes with aqueous solutions to reduce handling and cleaning time.
- Formulation maximizes membrane life by avoiding high alkaline concentration spikes during cleaning chemicals addition.
- Free-rinsing action. Surfactant-free formulation reduces cleaning cycle time and water use.

Safe to Use

- Suitable for incidental contact with food processing equipment. FDA opinion letter available.
- Environmentally responsible, CHLORINE-FREE and EDTA-FREE formulation.
- Compatible with alkaline and oxygenated KOCHKLEEN membrane cleaners enabling use over a wide range of membrane applications and operating parameters.

PHYSICAL PROPERTIES

State: Liquid
Appearance: Clear to light amber
Odor: Pungent
Solubility: Complete in water
@ 68 °F (20 °C)

Specific Gravity: 1.317 @ 68 °F (20 °C)
Freezing Point: ND
pH (1% solution): > 12.55
Weight: 10.7 lbs./gallon (1.28 kg/L)

KOCHKLEEN® 222 MEMBRANE CLEANER

USE INSTRUCTIONS

- For typical cleaning-in-place (CIP) applications, use 0.2 - 2.0% (v/v) KOCHKLEEN 222 membrane cleaner depending on membrane type and pH limitations.
- Circulate as required and recommended by KMS.
- Always consult the membrane manufacturer for specific procedures.

Refer to your Systems operating Manual or contact KMS Chemicals Group at 800-343-0499, fax at 978-694-7020, for specific cleaning temperatures and times. For precautionary measures and first aid information, refer to the Material Safety Data Sheet (MSDS) or the product label.

KMS PART NUMBERS

KOCHKLEEN® 222
KOCHKLEEN® 222

5 gallon (18.9 liter)
55 gallon (208.2 liter)

KPN 3430005
KPN 3430055

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

USA: 850 Main Street, Wilmington, MA 01887-3388, Telephone: 800-343-0499, Telephone: 978-657-4250, Fax: 978-657-5208

USA: 10054 Old Grove Road, San Diego, CA 92131, Telephone: 800-525-4369, Telephone: 858-695-3840, Fax 858-695-2176

UK: The Granary, Telegraph Street, Stafford, ST17 4AT, Telephone: +44-1785-272500, Fax: +44-1785-223149

AUSTRALIA: Suite 6, Level 1, 186-190 Church Street, Parramatta, NSW 2150, Tel: +61 2 8833 4640, Fax: +61 2 9689 3615

KOCHKLEEN® is a registered trademark of Koch Membrane Systems, Inc.
Koch Membrane Systems, Inc. is a member of Koch Chemical Technology Group, LLC.
© 2004 Koch Membrane Systems, Inc. All rights reserved worldwide. 06/04

06/04 Technical Data Sheet



MATERIAL SAFETY DATA SHEET

1 CHEMICAL PRODUCT & COMPANY IDENTIFICATION

TRADE NAME(S) **KOCHKLEEN® 222**
CAS NUMBER MIXTURE
MSDS NUMBER 9036
PRODUCT CODE ND
PRODUCT USE CLEANING AGENT



MANUFACTURER / SUPPLIER Koch Membrane Systems, Inc.
850 Main Street
Wilmington, MA
01887 USA

TELEPHONE NUMBERS - 24 HOUR ASSISTANCE

Canutec: 613-996-6666
Chemtec: 800-424-9300 (inside USA)
+1-703-527-3887 (outside USA)

TELEPHONE NUMBERS - GENERAL ASSISTANCE

(8-5, M-F EST) Product 978-657-4250
Assistance

For technical assistance regarding this product, please contact your local Koch Membrane Systems representative.

2 COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient Name	CAS Number	Concentration*	Exposure Limits / Health Hazards
SODIUM HYDROXIDE	1310-73-2	15 - 30 %	2 mg/m3 8-Hour TWA (OSHA) 2 mg/m3 CEILING (ACGIH)
DECYL(SULFOPHENOXY) BENZENESULFONIC ACID, DISODIUM SALT	36445-71-3	1 - 5 %	ND

*Values do not reflect absolute minimums and maximums; these values are typical which may vary from time to time.

WHMIS Classification: D2B, E.

3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER!

HEALTH HAZARDS

CORROSIVE TO THE SKIN, EYES AND RESPIRATORY TRACT

OVEREXPOSURE MAY CAUSE TEMPORARY OR PERMANENT BLINDNESS

MAY BE HARMFUL OR FATAL IF SWALLOWED

**SEE "TOXICOLOGICAL INFORMATION" (SECTION 11) FOR MORE INFORMATION

FLAMMABILITY HAZARDS

NON-COMBUSTIBLE

REACTIVITY HAZARDS

STABLE

POTENTIAL HEALTH EFFECTS, SKIN

CORROSIVE. Contact may cause reddening, itching, inflammation, burns, blistering and possibly severe tissue damage. Burns may not become symptomatic for several hours after contact.

POTENTIAL HEALTH EFFECTS, EYE

CORROSIVE. Exposure may cause severe burns, destruction of eye tissue and possible permanent injury or blindness.

Exposure may cause sensitivity to light.

POTENTIAL HEALTH EFFECTS, INHALATION

EXTREMELY IRRITATING AND CORROSIVE. Symptoms may include throat burns, constriction of the windpipe (bronchospasms), severe pulmonary edema and death, depending on the concentration and duration of exposure. Symptoms may include sore throat, coughing, labored breathing, sneezing and burning sensation, depending on the concentration and duration of exposure.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

Other specific symptoms of exposure are listed under "Toxicological Information" (Section 11).

POTENTIAL HEALTH EFFECTS, INGESTION

CORROSIVE. May cause painful irritation and burning of the mouth and throat, painful swallowing, labored breathing, burns or perforation of the gastrointestinal tract leading to ulceration and secondary infection.

Aspiration into lungs may cause chemical pneumonia and lung damage.

Overexposure to this material may cause systemic damage including target organ effects listed under "Toxicological Information" (Section 11).

4 FIRST AID MEASURES

SKIN

Immediately flush skin with plenty of water, for at least 15 minutes, while removing contaminated clothing and shoes. GET IMMEDIATE MEDICAL ATTENTION.

Place contaminated clothing in closed container for storage until laundered or discarded. If clothing is to be laundered, inform person performing operation of contaminant's hazardous properties. Discard contaminated leather goods.

EYE

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

INHALATION

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen.

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

INGESTION

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Never give anything by mouth to an unconscious person. Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis.

Have victim rinse mouth thoroughly with water, then drink 8 to 10 oz. of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have the victim lean forward to reduce risk of aspiration. Repeat administration of water. Quickly transport to emergency care facility.

NOTES TO PHYSICIAN

If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

Treat as an alkali corrosive; these agents damage the gastrointestinal tract by liquefaction necrosis which permits deep tissue penetration. Severe alkali burns may extend to adjacent viscera. Acute symptoms may not indicate the severity of tissue injury, but signs of chronic injury may include drooling, inability to swallow, erythema and/or ulceration of the oral pharynx, hematemesis, and occasionally shock and respiratory distress. Necrosis and associated inflammatory processes peak at 48 hours, but extend up to 4 days. Initial healing processes occur during the period of 4-14 days, but the esophageal wall is the weakest during this period and the hazard of perforation is greatest.

5 FIRE FIGHTING MEASURES

HAZARDOUS COMBUSTION PRODUCTS

Combustion may produce sodium oxides, peroxides, sulfides and carbonates.

EXTINGUISHING MEDIA

Use water spray, dry chemical, alcohol foam, all purpose AFFF or carbon dioxide to extinguish fire.

BASIC FIRE FIGHTING PROCEDURES

Evacuate area and fight fire from a safe distance.

Use water spray to cool adjacent structures and to protect personnel. Shut off source of flow if possible. Stay away from storage tank ends. Withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Firefighters must wear MSHA/NIOSH approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

Flash Point	PRODUCT DOES NOT FLASH
Autoignition Temperature	NA
Flammability Limits in Air, Lower, % by Volume	NA
Flammability Limits in Air, Upper, % by Volume	NA

6 ACCIDENTAL RELEASE MEASURES

EMERGENCY ACTION

Keep unnecessary people at least 150 feet upwind of spill; greater distances may be necessary for people downwind. Isolate hazard area and deny entry. See Exposure Control/Personal Protection (Section 8).

ENVIRONMENTAL PRECAUTIONS

If product is released to the environment, take immediate steps to stop and contain release. Caution should be exercised regarding personnel safety and exposure to the released product.

Notify local, provincial and/or federal authorities, if required.

SPILL OR LEAK PROCEDURE

Keep unnecessary people away. Isolate area for at least 25-50 meters (80-160 feet) to preserve public safety. For large spills, consider initial evacuation for at least 300 meters (1000 feet).

Large Spills: Dike far ahead of spill to contain until disposal. Neutralize spill with a weak acid such as vinegar or acetic acid. Stop leak when safe to do so.

Do not touch or walk through spilled material.

See Exposure Controls/Personal Protection (Section 8).

7 HANDLING & STORAGE

HANDLING

Do not inhale vapors or mists.

Do not eat, drink or smoke in areas of use or storage.

STORAGE

Store in tightly closed containers in cool, dry area away from heat and incompatibles. Avoid contact with strong oxidizers, acids, metals, explosives and organic peroxides.

Empty containers may contain product residue. Do not reuse without adequate precautions.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

General or local exhaust ventilation and other forms of engineering controls are the preferred means for controlling exposures.

EYE PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Wear chemical safety goggles and face shield. Have eye washing facilities readily available where eye contact can occur.

SKIN PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Avoid skin contact with this material.

If skin contact is anticipated, protective clothing, including impervious gloves, should be worn. Additional protection may be necessary to prevent skin contact including use of apron, armcovers, face shield, or boots. Provide safety showers at any location where skin contact can occur.

Use good personal hygiene.

RESPIRATORY PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

A NIOSH/MSHA approved air purifying respirator with a HEPA cartridge or canister may be appropriate under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

9 PHYSICAL & CHEMICAL PROPERTIES

ODOR AND APPEARANCE

CLEAR, LIGHT AMBER COLORED LIQUID WITH PUNGENT ODOR

Boiling Point	ND
Specific Gravity	1.317 AT 68 °F (20 °C)
Melting Point	ND
Percent Volatile	ND
Vapor Pressure	ND
Vapor Density	ND
Bulk Density	10.6 LBS/GAL
Solubility in Water	100 % COMPLETELY MISCIBLE
Octanol/Water Partn	ND
Volatile Organic	ND
Pour Point	ND
pH Value	> 13 [11.84 (1% solution)]
Freezing Point	ND
Viscosity	ND
Evaporation Rate	ND
Molecular Formula	ND
Molecular Weight	MIXTURE
Chemical Family	ALKALI HYDROXIDE
Odor Threshold	ND

10 STABILITY & REACTIVITY

STABILITY/INCOMPATIBILITY

Incompatible with strong oxidizing agents & acids, chlorinated hydrocarbons, peroxides, tin, zinc, copper, bronze and brass. Generates heat when mixed with water or acids.

See precautions under Handling & Storage (Section 7).

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS

Combustion may produce sodium oxides, peroxides, sulfides and carbonates.

Contact with metals such as aluminum, tin and zinc can generate hydrogen, a highly flammable gas.

Corrosion of metal can occur at temperatures above 140 °F (60 °C). Absorbs carbon dioxide from the air to form carbonates.

11 TOXICOLOGICAL INFORMATION

ROUTES OF EXPOSURE

Inhalation, ingestion, skin and eye contact.

TOXICOLOGICAL DATA

Acute or chronic overexposure to this material or its components may cause systemic toxicity, including adverse effects to the following: kidney, liver, skin, eyes and respiratory system.

Exposure to components of this material may cause the following specific symptoms, depending on the concentration and duration of exposure: bloody vomit and cardiovascular collapse.

CARCINOGENICITY

Ingredients in the product are not listed by NTP, IARC or OSHA.

PRE-EXISTING CONDITIONS AGGRAVATED BY EXPOSURE

Pre-existing medical conditions which may be aggravated by exposure include disorders of the skin, eye and respiratory system.

12 ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Contains substance(s) that may be moderately toxic to aquatic organisms on an acute basis (LD50/EC50 between 1 and 10 mg/l in the most sensitive species tested).

13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

This product, as supplied, when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR 261) due to its corrosivity.. Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user of the product to determine, at the time of disposal, whether the material is a hazardous waste subject to RCRA.

The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.

In Canada, wastes should be disposed of according to federal, state, provincial and local regulations.

14 TRANSPORT INFORMATION

BILL OF LADING - BULK (U. S. DOT)

Sodium Hydroxide Solution, 8, UN1824, PG II

BILL OF LADING - NON-BULK (U. S. DOT)

Sodium Hydroxide Solution, 8, UN1824, PG II

The above description may not cover shipping in all cases, please consult 49 CFR 172.101 for specific shipping information.

15 REGULATORY INFORMATION

FEDERAL REGULATIONS

All components of this product are listed on the TSCA Inventory.

This product, as supplied, contains sodium hydroxide, a Hazardous Substance as per 40 CFR Part 302.4. The reportable quantity for sodium hydroxide is 1000 pound(s). Any release of this product that results in a release of sodium hydroxide equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and 40 CFR 355.40, respectively. Failure to report may result in substantial civil and criminal penalties. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations.

This product does not contain toxic chemicals (in excess of the applicable de minimis concentration) that are subject to the annual toxic chemical release reporting requirements of the Superfund Amendments and Reauthorization Act (SARA) Section 313 (40 CFR 372).

This product contains one or more components designated as hazardous substances or toxic pollutants pursuant to the Federal Clean Water Act (40 CFR 116.4 Table A; 40 CFR 401.15). Any unpermitted introduction of this product into a facility stormwater or wastewater discharge may constitute a violation of the Clean Water Act. Facilities must notify the appropriate permitting agency prior to introducing this product into the aforementioned discharges.

There may be specific regulations at the local, regional or state/provincial level that pertain to this product.

SARA TITLE III RATINGS

Immediate Hazard:	X	Delayed Hazard:	X	Fire Hazard:	-	Pressure Hazard:	-
Reactivity Hazard:	-						

STATE REGULATIONS

Based on available information this product does not contain any components or chemicals currently known to the State of California to cause cancer, birth defects or reproductive harm at levels which would be subject to Proposition 65. Reformulation, use or processing of this product may affect its composition and require re-evaluation.

PENNSYLVANIA - Non-hazardous ingredients present at >3%: Water, CAS# 7732-18-5

INTERNATIONAL REGULATIONS

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and this MSDS contains all the information required by the CPR.

WHMIS Classification: D2B, E.

All known major components of this product are listed on the Canadian DSL.

WHMIS RATINGS

Compressed Gas		Flammable/Combustible		Oxidizer		Acutely Toxic	
Other Toxic Effects	X	Bio Hazardous		Corrosive	X	Dangerously Reactive	

NFPA RATINGS

Health	3	Flammability	0	Reactivity	0	Special Hazards	-
--------	---	--------------	---	------------	---	-----------------	---

HMIS RATINGS

Health	3	Flammability	0	Reactivity	0
--------	---	--------------	---	------------	---

16 OTHER INFORMATION

DISCLAIMER

NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, MSDS may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, expressed or implied, is made as to the accuracy or comprehensiveness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Current Revision Date 19-May-2008

Replaces Sheet Dated 17-Apr-2005

Completed By Koch Chemical Technology Group, LLC, call (978) 694-7346 or (978) 657-4250



KOCHKLEEN[®] UC III MEMBRANE CLEANER

Concentrated, Liquid Nonionic Surfactant Membrane Cleaner

DESCRIPTION

KOCHKLEEN UC III membrane cleaner is a specially formulated, concentrated nonionic detergent commonly used to dissolve and remove fats, proteins and other non-living organic foulants.

COMPATIBLE MEMBRANES

Reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF) membranes.

APPLICATIONS

KOCHKLEEN UC III membrane cleaner is commonly used in food, dairy, beverage and general in-process applications.

ADVANTAGES

Improves Membrane Performance

- Formulated and tested by KMS filtration and chemical experts to provide superior membrane cleaning.
- Quickly penetrates membrane pores to emulsify and suspend contaminants that cause membrane fouling and possible product contamination.
- Compatible with alkaline, acidic, oxygenated and chlorinated KOCHKLEEN membrane cleaners, enabling use over a wide range of membrane filtration applications and operating parameters.

Provides Cost Savings

- Concentrated formula promotes low use cost at recommended levels.
- Automatic dispensing capability ensures accurate dosing and minimizes overuse.
- Multiple use application potential reduces total cleaning product inventories.
- Readily mixes with aqueous solutions to reduce handling and cleaning time.
- Free-rinsing action reduces cleaning cycle time and water use.

Safe to Use

- Suitable for incidental contact with food processing equipment. FDA opinion letter available. Certified kosher pareve.



PHYSICAL PROPERTIES

State: Liquid
Appearance: Pale yellow
Odor: Slight
Solubility: >10% in water

Specific Gravity: 1.055 @ 77 °F (25 °C)
Freezing Point: 41 °F (5 °C)
pH (1% solution): 7
Weight: 8.8 lbs./gallon (1.06 kg/L)

KOCHKLEEN® UC III MEMBRANE CLEANER

USE INSTRUCTIONS

- For typical cleaning-in-place (CIP) applications, use 0.1 – 2.0% (v/v) KOCHKLEEN UC III membrane cleaner.
- Circulate as required and recommended by KMS.
- Always consult the membrane manufacturer for specific procedures.

Refer to your Systems operating Manual or contact KMS Chemicals Group at 800-343-0499, fax at 978-694-7020, for specific cleaning temperatures and times. For precautionary measures and first aid information, refer to the Material Safety Data Sheet (MSDS) or the product label.

KMS PART NUMBERS

KOCHKLEEN® UC III

Bulk Shipment	KPN 3452201
275 gallon (1040 liter)	KPN 2000360-275
55 gallon (208.2 liter)	KPN 3452255
5 gallon (18.9 liter)	KPN 3452205

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

Koch Membrane Systems, Inc., www.kochmembrane.com

Corporate Headquarters: 850 Main Street, Wilmington, Massachusetts 01887-3388, US, Tel. Toll Free: 1-888-677-5624, Telephone: 1-978-694-7000, Fax: 1-978-657-5208
European Headquarters: Koch Chemical Technology Group Ltd., Units 3-6, Frank Foley Way, Stafford ST16 2ST, GB, Telephone: +44-178-527-2500, Fax: +44-178-522-3149

• San Diego US • Aachen DE • Lyon FR • Madrid ES • Milan IT • Wijnegem BE • Beijing & Shanghai CN • Mumbai & Chennai IN • Melbourne & Sydney AU • Singapore • Sao Paulo BR • Manama BH •

The FLOW LINES DESIGN is a registered trademark of Koch Membrane Systems, Inc. in the US and other countries.

The STYLIZED K is a registered trademark of Koch Industries, Inc. in the US and other countries.

KOCHKLEEN is a registered trademark of Koch Membrane Systems, Inc.

Koch Membrane Systems, Inc. is a Koch Chemical Technology Group, LLC company.

© 2009 Koch Membrane Systems, Inc. All rights reserved worldwide. 10/09



MATERIAL SAFETY DATA SHEET

1 CHEMICAL PRODUCT & COMPANY IDENTIFICATION

TRADE NAME(S) KOCHKLEEN® UC III
CAS NUMBER See Below
MSDS NUMBER 14
PRODUCT CODE ND
PRODUCT USE CLEANING AGENT
SYNONYM(S) KOCHKLEEN® ULTRACLEAN III



MANUFACTURER / SUPPLIER Koch Membrane Systems, Inc.
850 Main Street
Wilmington, MA
01887 USA

TELEPHONE NUMBERS - 24 HOUR ASSISTANCE

Canutec: 613-996-6666
Chemtec: 800-424-9300 (inside USA)
+1-703-527-3887 (outside USA)

TELEPHONE NUMBERS - GENERAL ASSISTANCE

(8-5, M-F EST) Product Assistance 978-657-4250

For technical assistance regarding this product, please contact your local Koch Membrane Systems representative.

2 COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient Name	CAS Number	Concentration*	Exposure Limits / Health Hazards
NONYLPHENOL, ETHOXYLATED	9016-45-9	< 100 %	ND
GLYCOL ETHER	NA	< 3 %	ND
ETHYLENE OXIDE	75-21-8	< 10 PPM	1 ppm 8-Hour TWA (OSHA) 5 ppm 15-Min STEL (OSHA) 1 ppm 8-Hour TWA (ACGIH)

*Values do not reflect absolute minimums and maximums; these values are typical which may vary from time to time.

WHMIS Classification: D2B

3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

CAUTION!

HEALTH HAZARDS

MAY BE IRRITATING TO THE SKIN, EYES AND RESPIRATORY TRACT

**SEE "TOXICOLOGICAL INFORMATION" (SECTION 11) FOR MORE INFORMATION

FLAMMABILITY HAZARDS

COMBUSTIBLE AT HIGH TEMPERATURES

REACTIVITY HAZARDS

STABLE

POTENTIAL HEALTH EFFECTS, SKIN

MAY BE IRRITATING.

Repeated or prolonged skin contact may cause reddening, itching and inflammation.

POTENTIAL HEALTH EFFECTS, EYE

MODERATELY TO SEVERELY IRRITATING. Direct contact may cause irritation, redness, tearing and blurred vision.

POTENTIAL HEALTH EFFECTS, INHALATION

Breathing of the mists, vapors or fumes may irritate the nose, throat and lungs. Mists may also cause headache, nausea, and drowsiness.

POTENTIAL HEALTH EFFECTS, INGESTION

Ingestion of large amounts may cause gastrointestinal disturbances. Symptoms may include salivation, pain, nausea, vomiting and diarrhea.

FIRST AID MEASURES

SKIN

Immediately wash skin with plenty of soap and water while removing contaminated clothing and shoes. Get medical attention if irritation develops or persists.

Place contaminated clothing in closed container for storage until laundered or discarded. If clothing is to be laundered, inform person performing operation of contaminant's hazardous properties. Discard contaminated leather goods.

EYE

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

INHALATION

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen.

Get medical attention.

INGESTION

Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Never give anything by mouth to an unconscious person. Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis.

Have victim rinse mouth thoroughly with water, then drink 8 to 10 oz. of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have the victim lean forward to reduce risk of aspiration. Repeat administration of water. Quickly transport to emergency care facility.

NOTES TO PHYSICIAN

Gastric lavage may be indicated if ingested. If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

5 FIRE FIGHTING MEASURES

HAZARDOUS COMBUSTION PRODUCTS

Combustion may produce COx, irritating aldehydes and ketones.

EXTINGUISHING MEDIA

Use dry chemical, alcohol foam, all purpose AFFF or carbon dioxide to extinguish fire. Water or foam may cause frothing, with further application leading to boilover.

BASIC FIRE FIGHTING PROCEDURES

Evacuate area and fight fire from a safe distance.

If leak or spill has not ignited, ventilate area and use water spray to disperse gas or vapor and to protect personnel attempting to stop a leak.

Use water spray to cool adjacent structures and to protect personnel. Shut off source of flow if possible. Stay away from storage tank ends. Withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Firefighters must wear MSHA/NIOSH approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

UNUSUAL FIRE & EXPLOSION HAZARDS

May produce a floating fire hazard.

Flash Point	480 °F (237.8 °C) PMCC
Autoignition Temperature	ND
Flammability Limits in Air, Lower, % by Volume	ND
Flammability Limits in Air, Upper, % by Volume	ND

6 ACCIDENTAL RELEASE MEASURES

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind. (See Exposure Controls/Personal Protection in Section 8.)

ENVIRONMENTAL PRECAUTIONS

If product is released to the environment, take immediate steps to stop and contain release. Caution should be exercised regarding personnel safety and exposure to the released product. Notify local, provincial and/or federal authorities, if required.

SPILL OR LEAK PROCEDURE

Keep ignition sources out of area and shut off all ignition sources. Absorb spill with inert material (e. g. dry sand or earth) then place in a chemical waste container. Large Spills: Dike far ahead of liquid spill for later disposal. Stop leak when safe to do so.

Avoid clean up procedures that may result in water pollution.

DO NOT put water directly on leak or spill area. See Exposure Controls/Personal Protection (Section 8).

7 HANDLING & STORAGE

HANDLING

Ground lines and equipment used during transfer to reduce the possibility of static spark-initiated fire or explosion. Use non-sparking tools. Do not cut, grind, drill, weld in the vicinity of the product or reuse containers unless adequate precautions are taken against these hazards.

Do not eat, drink or smoke in areas of use or storage.

STORAGE

Store in tightly closed containers in a cool, dry, isolated, well-ventilated area away from heat, sources of ignition and incompatibles. Avoid contact with strong oxidizers.

Empty containers may contain product residue. Do not reuse without adequate precautions.

Ethylene oxide may collect in container head space. Although concentrations are expected to remain below permissible exposure limits, access and work with open containers and tanks with adequate ventilation.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

General or local exhaust ventilation and other forms of engineering controls are the preferred means for controlling exposures.

EYE PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Wear chemical safety goggles and face shield. Have eye washing facilities readily available where eye contact can occur.

SKIN PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Avoid skin contact with this material.

Provide safety showers at any location where skin contact can occur. Use good personal hygiene.

RESPIRATORY PROTECTION: PERSONAL PROTECTION EQUIPMENT (PPE)

Under normal conditions of use, ventilation and engineering controls are sufficient. If irritation is evident, and/or a non-routine or emergency situation, NIOSH/MSHA approved breathing equipment may be required.

9 PHYSICAL & CHEMICAL PROPERTIES

ODOR AND APPEARANCE

PALE YELLOW LIQUID WITH A SLIGHT ODOR

Boiling Point	ND
Specific Gravity	1.06
Melting Point	41 °F (5 °C)
Percent Volatile	ND
Vapor Pressure	< 1 mmHg at 68 °F (20° C)
Vapor Density	> 1
Bulk Density	ND
Solubility in Water	> 10 %
Octanol/Water Partn	ND
pH Value	7
Freezing Point	SEE MELTING POINT
Viscosity	110 at 100 °F (37.7 °C)
Evaporation Rate	ND
Molecular Formula	NA
Molecular Weight	ND
Chemical Family	NONIONIC SURFACTANT
Odor Threshold	ND

10 STABILITY & REACTIVITY

STABILITY/INCOMPATIBILITY

None known. See precautions under Handling & Storage (Section 7).

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS

Combustion may produce COx.

11 TOXICOLOGICAL INFORMATION

ROUTES OF EXPOSURE

Inhalation, ingestion, skin and eye contact.

LD50

ND

LC50

ND

TERATOGENICITY, MUTAGENICITY, OTHER REPRODUCTIVE EFFECTS

Some polyethylene glycol compounds have produced fetal effects in animal studies.

12 ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

ND

13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

This product, as supplied, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261). Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user of the product to determine, at the time of disposal, whether the material is a hazardous waste subject to RCRA.

The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.

In Canada, wastes should be disposed of according to federal, state, provincial and local regulations.

14 TRANSPORT INFORMATION

BILL OF LADING - BULK (U. S. DOT)

Non-Regulated

BILL OF LADING - NON-BULK (U. S. DOT)

Non-Regulated

15 REGULATORY INFORMATION

FEDERAL REGULATIONS

All components of this product are listed on the TSCA Inventory.

This product, as supplied, may contain ethylene oxide, a Hazardous Substance as per 40 CFR Part 302.4. The reportable quantity for ethylene oxide is 10 pound(s). Any release of this product that results in a release of ethylene oxide equal to or exceeding the reportable quantity must be reported to the National Response Center (800-424-8802) and appropriate state and local regulatory agencies as described in 40 CFR Part 302.6 and CFR 355.40, respectively.

Failure to report may result in substantial civil and criminal penalties. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations.

This product contains one or more substances listed as hazardous, toxic or flammable air pollutants under Section 112 of the Clean Air Act.

SARA TITLE III RATINGS

Immediate Hazard:	X	Delayed Hazard:	X	Fire Hazard:	-	Pressure Hazard:	-
Reactivity Hazard:	-						

Following ingredients of this product are listed in SARA313

SARA Listed Ingredient Name	CAS Number	Maximum %
GLYCOL ETHER	NA	3.0

STATE REGULATIONS

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

PENNSYLVANIA - Non-hazardous ingredients present at >3%: None

INTERNATIONAL REGULATIONS

CANADA

All known major components of this product are listed on the Canadian DSL.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and this MSDS contains all the information required by the CPR.

WHMIS Classification: D2B

WHMIS RATINGS

Compressed Gas	-	Flammable/Combustible	-	Oxidizer	-	Acutely Toxic	-
Other Toxic Effects	X	Bio Hazardous	-	Corrosive	-	Dangerously Reactive	-

NFPA RATINGS

Health	1	Flammability	1	Reactivity	0	Special Hazards
--------	---	--------------	---	------------	---	-----------------

HMIS RATINGS * - Indicates chronic health hazard

Health	1*	Flammability	1	Reactivity	0
--------	----	--------------	---	------------	---

OTHER INFORMATION

DISCLAIMER

NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, MSDS may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, expressed or implied, is made as to the accuracy or comprehensiveness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Current Revision Date 03-Aug-2005

Replaces Sheet Dated 19-Jul-2005

Completed By Safety & Emergency Response, Koch Chemical Technology Group, LLC

Aquamark, Inc.

AQ 120

Material Safety Data Sheet

Page 1 of 4

Section 1 - Chemical Product and Company Identification

Product/Chemical Name:

Aluminum Sulfate, Liquid

Manufacturer:

Aquamark, Inc.
PO Box 773
Chesterland, OH 44026
Phone 440-564-4227
FAX 440-564-1255

Chemical Formula:

$\text{Al}_2(\text{SO}_4)_3 \cdot 14(\text{H}_2\text{O})$

CAS Number:

10043-01-3

General Use:

Water Treatment Chemical

Emergency Contact:

800-424-9300

Chemtrec

HMIS

H 1
F 0
R 0
PPE - sec 8

Section 2 - Composition / Information on Ingredients

Ingredient Name	CAS Number	% wt
Aluminum sulfate	10043-01-3	27.8
Water	7732-18-5	72.2

OSHA PEL		ACGIH TLV		NIOSH REL		NIOSH	
Ingredient	TWA	STE L	TWA	STEL	TWA	STE L	IDL H
Aluminum sulfate	2 mg/m3 as aluminum	none estab	2 mg/m3 as aluminum	none estab	2 mg/m3 as aluminum	none estab	none estab

Section 3 - Emergency Overview

Description: Clear, amber or light green liquid. pH ± 2.1 . Not volatile. Not flammable.

Hazards: Harmful by ingestion and in contact with skin. Irritating to eyes, respiratory system and skin. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Section 4 - First Aid Procedures

Inhalation: (mist or spray) Remove from exposure, seek medical treatment if any symptoms occur.

Eye Contact: Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention.

Skin Contact: Remove contaminated clothing and wash contaminated skin with water.

Ingestion: Do not induce vomiting, drink milk or water and immediately seek medical attention.

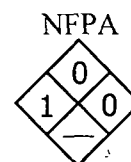
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 5 - Physical and Chemical Properties

Physical State:	Liquid	Water Solubility:	Complete
Appearance:	colorless, clear amber or light green	Boiling Point:	109° C/228° F
		Freezing/Melting Point:	-13° C/9° F
Odor:	Negligible odor	Viscosity:	25 cps @ 20°C/68° F
Vapor Pressure:	NA	Vapor Density (Air=1):	NA
Specific Gravity (H₂O=1, at 15.5°C/60 °F):	1.33	% VOC:	0.0
		pH:	2.1 ± 0.5

Section 6 - Fire-Fighting Measures

Flash Point:	NA
Burning Rate:	NA
Autoignition Temperature:	NA
LEL:	NA
UEL:	NA
Flammability Classification:	Not flammable
Extinguishing Media:	NA
Unusual Fire or Explosion Hazards:	If evaporated to dryness and exposed to temperatures greater than 1400°F aluminum sulfate will decompose generating toxic and corrosive gas.
Hazardous Combustion Products:	See Section 7.
Fire-Fighting Instructions:	Do not release runoff from fire control methods to sewers or waterways.



Section 7 - Stability and Reactivity

Stability:	Stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization:	Hazardous polymerization cannot occur.
Chemical Incompatibilities:	Alkalies and water-reactive materials.
Conditions to Avoid:	N/A
Hazardous Decomposition Products:	Thermal oxidative decomposition of Aluminum Sulfate occurs at temperatures greater than 1400°F and can produce sulfur oxides.

Section 8 - Health Hazard Information

Primary Entry Routes:	Ingestion
Target Organs:	N/A
Acute Effects	No unusual
Eye:	Irritating to eyes.
Skin:	Irritating to skin.
Ingestion:	Harmful if swallowed.
Carcinogenicity:	IARC, NTP, and OSHA do not list Aluminum Sulfate, Liquid as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure:	
Chronic Effects:	None reported. IARC, NTP, and OSHA list no evidence showing that any of the ingredients cause cancer or affect reproduction.

Section 9 - Spill, Leak, and Disposal Procedures

Spill /Leak Procedures:	Spill procedures are dictated by site wastewater flow controls and will vary from site to site. General procedures are provided in this document, but authorization for any wastewater discharge must be obtained prior to the discharge.
Small Spills:	If directed to an industrial sewer, wash down with large volumes of water. Spills can be neutralized and absorbed with soda ash or lime, but neutralization will release carbon dioxide, which can generate a breathing hazard.
Large Spills	For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways. Pump residue into storage containers or neutralize with lime or soda ash. Neutralization will release carbon dioxide, which can generate a breathing hazard.
Cleanup:	Wash or neutralize impacted areas after liquid removal to remove residues.
Regulatory Requirements:	Follow applicable OSHA regulations (29 CFR 1910.120). Aluminum sulfate has a reportable quantity under CERCLA.
Disposal:	Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Container Cleaning and Disposal:	Rinse with water, dispose of containers in accordance with State and local regulations.

Section 10 - Regulatory Data

RCRA Hazardous Waste Number:	Not a characteristic waste (40 CFR §261.20-.24) Not listed waste (40 CFR §261.30-.38)
CERCLA Hazardous Substance (40 CFR 302.4)	listed CWA, Sec. 311 (b)(4)
CERCLA Reportable Quantity (RQ)	5,000 lbs (2,270 kg) as Al ₂ (SO ₄) ₃ 17,900 lbs (8,120 kg) as a 27.8% solution
SARA 311/312 Codes:	immediate (acute) health hazard
SARA Toxic Chemical (40 CFR 372.65):	Not listed

SARA EHS (Extremely Hazardous Substance) (40 CFR 355):	Not listed
OSHA Regulations:	
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A):	Not listed
OSHA Specifically Regulated Substance (29CFR 1910.)	Not listed
State Regulations:	Delta Chemical Corporation has not investigated state specific requirements.

Section 11 - Exposure Controls / Personal Protection

Ventilation:	Under normal conditions, liquid alum will not generate mists or vapors. No special ventilation is recommended.
Respiratory Protection:	Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear an MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or non-routine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment:	Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations:	Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment:	Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.
Comments:	Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 12 - Special Precautions and Comments

Handling Precautions:	Ensure that all containers are labeled in accordance with OSHA regulations. Avoid skin and eye contact. Wear appropriate protective clothing.
-----------------------	---

Section 13 - DOT Transportation Data (49 CFR 172.101)

Proper Shipping Name:	Environmentally Hazardous Substance, Liquid, N.O.S., 9, UN3082, III (Aluminum Sulfate, solution)
Shipping Symbols:	G

Hazard Class:	9
DOT No.:	UN3082
Packing Group:	III
Label:	Class 9
Special Provisions (172.102):	8, T1
NAERG 2000	Guide 171
Packaging Authorization:	
a) Exceptions	173.155
b) Non-bulk Packaging:	173.203
c) Bulk Packaging:	173.241
Quantity Limitations	
a) Passenger, Aircraft, or Railcar:	No limit
b) Cargo Aircraft Only:	No limit
Vessel Stowage Requirement	
a) Vessel Stowage:	A
b) Other:	

Prepared By: Craig Owen

Revision Notes: 1/10/03, 10/1/04, 6/2/06, – Format revised. 10/16/03 Transportation data updated. 3/9/04 – PEL updated, proper shipping name added. 9/3/04 – Format revised.

Disclaimer: The information presented herein is believed to be accurate and reliable, but is given without guaranty or warranty, expressed or implied. The user should not assume that all safety measures are indicated so that other measures may not be required. The user is responsible for assuring that the product and equipment are used in a safe manner that complies with all appropriate legal standards and regulations.



MATERIAL SAFETY DATA SHEET

AQ 131

AQUAMARK, Inc. P.O. Box 773 Chesterland, OH 44026 Date: 4-22-03	Emergency Telephone Numbers: (440) 564-1227 AQUAMARK (weekdays) (800) 429-9300 Chemtrac (evenings & weekends) Revised Date: 09/08/2006
---	--

Section I: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: AQ 131

PRIMARY FUNCTION: METAL PRECIPITANT

CHEMICAL NAME: Hydropolysulfide, carbonothioylbis-, disodium salt. CAS# 128578-22-3

CHEMICAL FAMILY: Organic Sulfur

HMIS RATINGS: Health=1, Flammability=0, Reactivity=0

HMIS HAZARD INDEX: 0=MINIMAL, 1=SLIGHT, 2=MODERATE, 3=SERIOUS, 4=SEVERE

Section II: COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT (CAS #)	OSHA PEL (PPM)	ACGIH TLV (PPM)	OTHER
--------------------	-------------------	--------------------	-------

The components of this formulation and the precise composition is proprietary. Bona fide requests for disclosure to medical personnel must be made in accordance with the procedures in 29 CFR 1910.1200(i) 1-13.

While this material is not classified as hazardous under OSHA regulations, this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available to all users of this product.

Section III: HAZARDS IDENTIFICATION

EYES: May cause irritation and redness.

SKIN: Prolonged contact with skin may cause skin irritation.

INGESTION: See Section 4 below.

INHALATION: Mist or spray may cause irritation if inhaled.

Section IV: FIRST AID MEASURES

EYES: Flush eyes gently with water for at least 15 minutes while holding eyelids apart. Seek medical attention.

SKIN: Remove contaminated clothing and shoes and flush affected area with water for at least 15 minutes. Wash with soap and water. If irritation persists seek medical attention. Wash or discard contaminated clothing and shoes.

INGESTION: Immediately rinse mouth with water. Do not induce vomiting. Drink milk or water to dilute. If vomiting occurs, drink more liquids. Seek medical attention.

INHALATION: If respiratory distress occurs, get into fresh air and, if needed, administer oxygen and start CPR. Seek medical attention.

Section V: FIRE FIGHTING MEASURES

FLASH POINT: Not Applicable – water solution.

EXTINGUISHING MEDIA: Not Applicable – water solution

SPECIAL FIRE FIGHTING PROCEDURES: None

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

Section VI: ACCIDENTAL RELEASE MEASURES

SMALL SPILLS: Soak up with an absorbent and shovel into a waste container.

LARGE SPILLS: Contain spill and recover liquid for reprocessing or disposal.

WASTE DISPOSAL METHOD: Dispose of in accordance with local, state and federal regulations.

MATERIAL SAFETY DATA SHEET AQ 131

Section VII: HANDLING AND STORAGE

HANDLING AND STORAGE: Protect drum from damage, freezing and intense heat.

OTHER PRECAUTIONS: Wear protective eye goggles, gloves, boots and clothing.

Section VIII: EXPOSURE CONTROLS AND PERSONAL PROTECTION

EYE PROTECTION: Wear chemical splash-proof goggles.

PROTECTIVE GLOVES: Wear alkaline resistant gloves.

RESPIRATORY PROTECTION: None normally required.

VENTILATION: Always store and use all chemicals in well-ventilated areas.

OTHER PROTECTIVE EQUIPMENT: Wear protective clothing and boots suitable for protection from alkaline products. Provide eye wash and safety shower stations.

Section IX: PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT: 212°F

SPECIFIC GRAVITY: 1.04 – 1.06

EVAPORATION RATE: Not determined.

VAPOR DENSITY: Not determined.

VAPOR PRESSURE: Not determined.

SOLUBILITY IN WATER: Complete

pH of NEAT SOLUTION: 12.0 - <12.5

APPEARANCE/ODOR: Warm Red Liquid, Sulfur Odor

Section X: STABILITY AND REACTIVITY

STABILITY: Stable

HAZARDOUS POLYMERIZATION: Will not occur.

INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing agents or mineral acids.

HAZARDOUS DECOMPOSITION PRODUCTS: None Known.

Section XI: TOXICOLOGICAL INFORMATION

CHRONIC EFFECTS AND MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None noted.

SPECIAL NOTE: None of the components in this product are considered a carcinogen by OSHA, NTP or IARC. **TOXICITY TESTS** resulted in the following LC50 values after 48-hour static acute toxicity tests: Rainbow Trout @ 33.0 mg/l; Bluegill Sunfish @ 35.0 mg/l.

Section XII: ECOLOGICAL INFORMATION

No data.

Section XIII: DISPOSAL CONSIDERATIONS

This product, in its neat form, is not considered hazardous. After use in treating wastewater/groundwater, the characteristics of the treated solution will dictate the proper disposal in accordance with local, state and Federal regulations.

Section XIV: TRANSPORT INFORMATION

Non-regulated material.

Section XV: REGULATORY INFORMATION

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA):

Requires notification to the National Response Center of releases of quantities of Hazardous Substances equal to or greater than the reportable quantities (RQ) in 40 CFR 302.4. Components present in this product at a level which would require reporting under the statute are:

<u>Chemical</u>	<u>CAS Number</u>	<u>RQ</u>
NONE		

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III:

Requires emergency planning based on Threshold Planning Quantities (TPQs) and release reporting based on Reportable Quantities (RQ) in 40 CFR 355 (SARA 302, 304, 311 and 312) Components present in this product at a level which could require reporting under the statute are: NONE

Toxic Substances Control Act (TSCA) Status:

All components of this product are on the TSCA inventory.

EPA Priority Pollutants: NONE

RCRA Hazard Class: If discarded neat – non-hazardous.

Section XVI: OTHER INFORMATION

HMIS RATINGS: Health = 1, Flammability = 0, Reactivity = 0

HMIS HAZARD INDEX: 0 = MINIMAL, 1 = SLIGHT, 2 = MODERATE, 3 = SERIOUS, 4 = SEVERE

LEGEND:

CAS	Chemical Abstract Number
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
HMIS	Hazardous Materials Identification System
IARC	International Agency for Research on Cancer
MSDS	Material Safety Data Sheet
N/A	Not Applicable
NTP	National Toxicity Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act
TSCA	Toxic Substance Control Act
TLV	Threshold Limit Value

The information accumulated herein is believed to be accurate but is not warranted to be whether originating with the company or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. We do not assume any legal responsibility for same, nor do we give permission, inducement or recommendation to practice any patented invention without a license. It is offered solely for your consideration, investigation and verification. Before using any product, read its label.

**AQUAMARK, INC.****AQ 155**

Date: 06/08/03

AQUAMARK, INC.,
PO Box 773
Chesterland, OH 44026

Emergency Telephone Numbers
(440) 564-1227 Aquamark (weekdays)
(800)424-9300 Chemtrec (24 hrs.)

MATERIAL SAFETY DATA SHEET

SECTION I: GENERAL INFORMATION

PRODUCT NAME: AQ 155
PRODUCT CLASS: PRECIPITANT
FREIGHT CLASSIFICATION: 60
PRIMARY CHEMICAL FAMILY: Organic Sulfur
CHEMICAL NAME: Hydropolysulfide, CAS# 128578-22-3
HMIS RATINGS: Health=1, Flammability=0, Reactivity=0

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENT (CAS #)	OSHA PEL (PPM)	ACGIH TLV (PPM)	OTHER
--------------------	-------------------	--------------------	-------

No Hazardous Ingredients

*Other substances not "hazardous" per OSHA communication standard may be included.

Precise mixture is proprietary.

SECTION III: PHYSICAL/CHEMICAL DATA

BOILING POINT: 212° F.
SPECIFIC GRAVITY: 1.15
EVAPORATION RATE: Not Determined
VAPOR DENSITY: Not Determined
VAPOR PRESSURE: Not Determined
SOLUBILITY IN WATER: Complete
pH of NEAT SOLUTION: <12.5
APPEARANCE/ODOR: Red Liquid, Sulfur Odor

SECTION IV: FIRE AND EXPLOSION DATA

FLASH POINT: Not Applicable - water solution
EXTINGUISHING MEDIA: Not Applicable - water solution
SPECIAL FIRE FIGHTING PROCEDURES: None
UNUSUAL FIRE AND EXPLOSION HAZARDS: None

SECTION V: HEALTH HAZARD DATA EFFECTS OF OVEREXPOSURE - EMERGENCY & FIRST AID PROCEDURES

EYES: May cause irritation and redness. Flush eyes gently with water for at least 15 minutes while holding eyelids apart. Seek medical attention immediately.

SKIN: May cause irritation. Remove contaminated clothing and shoes and flush affected area with water for at least 15 minutes. Wash with soap and water. If irritation persists seek medical attention. Wash or discard contaminated clothing and shoes.

INGESTION: Immediately rinse mouth with water. Do not induce vomiting. Drink milk or water to dilute. If vomiting occurs, drink more liquids. Seek medical attention.

INHALATION: Mist or spray may cause irritation if inhaled. If respiratory distress occurs, get into fresh air and, if needed, administer oxygen and start CPR. Seek medical attention.

CHRONIC EFFECTS AND MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:

None noted.

SECTION VI: REACTIVITY DATA

STABILITY: Stable

HAZARDOUS POLYMERIZATION: Will not occur.

INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing agents or mineral acids.

HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen sulfide may be produced if heated to high temperatures. Carbon disulfide may be produced on contact with strong acids. Dimethylnitrosamines may be produced on contact with a combination of strong acids and nitration compounds.

Conditions to Avoid: Avoid high temperature and evaporation of water. Temperatures above 100C (212F).

DANGER- Do not acidify. Acidification releases flammable toxic gases.

SECTION VII: SPILL, LEAK, AND DISPOSAL PROCEDURES

SMALL SPILLS: Soak up with an absorbent and shovel into waste container.

LARGE SPILLS: Contain spills and recover liquids for reprocessing or disposal.

WASTE DISPOSAL METHOD: Dispose of in accordance with local, state and federal regulations.

SECTION VIII: PROTECTIVE MEASURES

EYE PROTECTION: Wear chemical splash-proof goggles

PROTECTIVE GLOVES: Wear alkaline resistant gloves.

RESPIRATORY PROTECTION: None normally required.

VENTILATION: Always store and use all chemicals in well ventilated areas.

OTHER PROTECTIVE EQUIPMENT: Wear protective clothing and boots suitable for protection from alkaline products. Provide eye wash and safety shower stations.

SECTION IX: SPECIAL PRECAUTIONS

HANDLING AND STORAGE: Protect drum from damage, freezing and intense heat.

OTHER PRECAUTIONS: Wear protective eye goggles, gloves, boots and clothing.

SECTION X: ECOLOGICAL INFORMATION

LC50 determinations without added suspended solids overestimate the true toxicity of polymers. Suspended solids and other dissolved organic materials like humic acid are present in natural waters and reduce the effective concentration of the polymer thereby its toxicity. Suspended solids and other dissolved organic materials like humic acid are present in natural waters and can reduce the toxicity of this product.

LC50:

Ceriodaphnia dubia: 24h LC50: 10.7 mg/L

Daphnia magna: 48h LC50: 8.0 mg/L

Pimephales Promelas: 96h LC50: 30.3 mg/L

SECTION XI: REGULATORY INFORMATION

FEDERAL EPA

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA):

Requires notification to the National Response Center of releases of quantities of Hazardous Substances equal to or greater than the reportable quantities (RQ) in 40 CFR 302.4. Components present in this product at a level which would require reporting under the statute are:

<u>Chemical</u>	<u>CAS Number</u>	<u>RQ</u>
Hydropolysulfide,	128578-22-3	N/A

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III:

Requires emergency planning based on Threshold Planning Quantities (TPQs) and release reporting based on Reportable Quantities (RQ) in 40 CFR 355 (SARA 302, 304, 311 and 312). Components present in this product at a level which could require reporting under the statute are: NONE

Toxic Substances Control Act (TSCA) Status:

All components of this product are on the TSCA inventory

EPA Priority Pollutants: NONE

AQ 155 msds

RCRA Hazard Class: Hydrogen sulfide, RCRA ,Class 55

OTHER INFORMATION

The information accumulated herein is believed to be accurate but is not warranted to be whether originating with the company or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances.

Material Safety Data Sheet



Sulfuric Acid

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sulfuric Acid

OTHER/GENERIC NAMES: Battery acid

PRODUCT USE: Industrial

MANUFACTURER: General Chemical Corporation
90 East Halsey Road
Parsippany, NJ 07054

FOR MORE INFORMATION CALL: 973-515-1840
(Monday-Friday, 9:00am-4:30pm)

IN CASE OF EMERGENCY CALL: 800-631-8050
(24 Hours/Day, 7 Days/Week)

2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>INGREDIENT NAME</u>	<u>CAS NUMBER</u>	<u>WEIGHT %</u>
Sulfuric acid	7664-93-9	>51
Water	7732-18-5	Balance

Trace impurities and additional material names not listed above may appear in Section 15 of this MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

OSHA Hazard Communication Standard: *This product is considered hazardous under the OSHA Hazard Communication Standard.*

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Oily, colorless to slightly yellow, clear to turbid liquid. Odorless. Causes severe skin burns. Causes severe eye burns. Causes burns of the mouth, throat, and stomach.

POTENTIAL HEALTH HAZARDS

SKIN: Causes severe burns.

EYES: Liquid contact can cause irritation, corneal burns, and conjunctivitis. May result in severe or permanent injury. May cause blindness.

INHALATION: Inhalation of fumes or acid mist can cause irritation or corrosive burns to the upper respiratory system, including the nose, mouth and throat. May irritate the lungs. May cause pulmonary edema.

INGESTION: Causes burns of the mouth, throat and stomach. May be fatal if swallowed. Hazards are also applicable to dilute solutions.

MATERIAL SAFETY DATA SHEET

Sulfuric Acid

DELAYED EFFECTS: Erosion of teeth, lesions of the skin, tracheo-bronchitis, mouth inflammation, conjunctivitis and gastritis. IARC and NTP have classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen. This classification is for inorganic acid mists only and does not apply to sulfuric acid or sulfuric acid solutions. The basis for the classifications rests on several epidemiology studies which have several deficiencies. These studies did not account for exposure to other substances, some known to be animal or potential human carcinogens, social influences (smoking or alcohol consumption) and included small numbers of subjects. Based on the overall weight of evidence from all human and chronic animal studies, no definitive causal relationship between sulfuric acid mist exposure and respiratory tract cancer has been shown.

Ingredients found on one of the three OSHA designated carcinogen lists are listed below.

<u>INGREDIENT NAME</u>	<u>NTP STATUS</u>	<u>IARC STATUS</u>	<u>OSHA LIST</u>
Sulfuric acid	Known carcinogen – sulfuric acid mist	1-Known carcinogen – sulfuric acid mist	Not listed

4. FIRST AID MEASURES

SKIN: Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing while washing. Get medical attention immediately.

EYES: Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.

INHALATION: If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

INGESTION: If swallowed, do NOT induce vomiting. Give victim two glasses of water. Call a physician immediately. Never give anything by mouth to an unconscious person.

ADVICE TO PHYSICIAN: Treat symptomatically.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT:	Not applicable.
FLASH POINT METHOD:	Not applicable.
AUTOIGNITION TEMPERATURE:	Not applicable.
UPPER FLAME LIMIT (volume % in air):	Not applicable.
LOWER FLAME LIMIT (volume % in air):	Not applicable.
FLAME PROPAGATION RATE (solids):	Not applicable.
OSHA FLAMMABILITY CLASS:	Not flammable.

EXTINGUISHING MEDIA:

Water spray or fog may be used to knock down corrosive vapor cloud. Water may be applied to the sides of the containers exposed to flames provided the water does not come in contact with the tank contents.

MATERIAL SAFETY DATA SHEET

Sulfuric Acid

UNUSUAL FIRE AND EXPLOSION HAZARDS:

Flammable and potentially explosive hydrogen gas can be generated inside metal drums and storage tanks. Concentrated sulfuric acid can ignite combustible materials on contact.

SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:

Do not use solid water streams near ruptured tanks or spills of sulfuric acid. Acid reacts violently with water and can spatter acid onto personnel. Wear approved positive-pressure self-contained breathing apparatus and protective clothing.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (See section 8 for recommended personal protective equipment.)

Dilute small spills or leaks cautiously with plenty of water. Neutralize residue with sodium bicarbonate or other suitable neutralizing agent. When using carbonates for neutralization, adequate precautions should be taken to minimize hazards from carbon dioxide gas-generation. No smoking in spill area. Major spills must be handled by a predetermined plan. Attempt to keep out of sewers.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (See section 8 for recommended personal protective equipment.)

Avoid contact with skin, eyes and clothing. Avoid breathing mist. Use appropriate personnel protective equipment. Do not add water to acid. When diluting, always add acid to water cautiously and with agitation. Use with adequate ventilation.

STORAGE RECOMMENDATIONS:

Protect from physical damage. Store in a cool, well-ventilated area away from combustibles and reactive chemicals. Keep out of sun and away from heat. Keep containers upright. No smoking in storage area.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:

Sufficient to reduce vapor and acid mists to permissible levels. Packaging and unloading areas and open processing equipment may require mechanical exhaust systems. Corrosion-proof construction recommended. Closed ventilation systems (e.g. vapor hoods) are frequently used in the electronics industry.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION: As a minimum, wear acid-resistant, preferably rubber, gloves and apron. Acid resistant boots, trousers and jacket may be used for increased protection.

EYE PROTECTION: Wear chemical safety goggles. Add a full faceshield for pouring liquids. Do not wear contact lenses.

MATERIAL SAFETY DATA SHEET

Sulfuric Acid

RESPIRATORY PROTECTION: Generally, none required. If misting conditions prevail, wear a NIOSH-approved acid-mist respirator.

ADDITIONAL RECOMMENDATIONS: Provide eyewash stations and quick-drench shower facilities in or near areas of use or handling.

EXPOSURE GUIDELINES

<u>INGREDIENT NAME</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER LIMIT</u>
Sulfuric acid	1 mg/m ³ – TWA 3 mg/m ³ – STEL	1 mg/m ³ – TWA	15 mg/m ³ – IDLH

¹ = Limit established by General Chemical Corporation.

² = Workplace Environmental Exposure Level (AIHA).

³ = Biological Exposure Index (ACGIH).

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:

None.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Colorless to light yellow liquid
PHYSICAL STATE:	Liquid
MOLECULAR WEIGHT:	98.08 (H ₂ SO ₄)
CHEMICAL FORMULA:	H ₂ SO ₄ (various concentrations) in water
ODOR:	Odorless
SPECIFIC GRAVITY (water = 1.0):	1.842
SOLUBILITY IN WATER (weight %):	100%
pH:	0.9 (1% solution)
BOILING POINT:	~310C (94%)
MELTING POINT:	~ -27C (94%)
VAPOR PRESSURE:	<0.001 mm Hg @ 20C
VAPOR DENSITY (air = 1.0):	Not applicable
EVAPORATION RATE:	Not applicable
% VOLATILES:	Not applicable
FLASH POINT:	Not applicable

COMPARED TO: Not applicable

(Flash point method and additional flammability data are found in Section 5.)

10. STABILITY AND REACTIVITY

NORMALLY STABLE? (CONDITIONS TO AVOID):

Normally stable. Avoid temperatures greater than 300C: yields sulfur trioxide gas, which is toxic, corrosive, and an oxidizer.

INCOMPATIBILITIES:

Nitro compounds, carbides, dienes, alcohols (when heated): causes explosions.

Oxidizing agents, such as chlorates and permanganates: causes fires and possible explosions.

Allyl compounds and aldehydes: undergoes polymerization, possibly violent.

Alkalies, amines, water, hydrated salts, carboxylic acid anhydrides, nitriles, olefinic organics, glycols, aqueous acids: causes strong exothermic reactions.



MATERIAL SAFETY DATA SHEET

Sulfuric Acid

Carbonates, cyanides, sulfides, sulfites, metals such as copper: yields toxic gases.

HAZARDOUS DECOMPOSITION PRODUCTS:

Sulfur trioxide gas.

HAZARDOUS POLYMERIZATION:

Will not occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:

LD₅₀ (oral-rat): 2140 mg/kg

LC₅₀ (inhl-rat): 510 mg/m³/2 hr

LC₅₀ (inhl-mouse): 320 mg/m³/2 hr

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:

IARC and NTP have classified "strong inorganic acid mists containing sulfuric acid" as known human carcinogens. The state of California has also listed "strong inorganic acid mists containing sulfuric acid" on the Proposition 65 list as a cancer causing agent. No definitive causal relationship between sulfuric acid mist exposure and respiratory cancer has been shown.

OTHER DATA:

None.

12. ECOLOGICAL INFORMATION

24.5 ppm/24 hr./bluegill/lethal/fresh water

42.5 ppm/48 hr./prawn/LC₅₀/salt water

13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? Yes

If yes, the RCRA ID number is: D002

OTHER DISPOSAL CONSIDERATIONS:

The information offered in section 13 is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT HAZARD CLASS: 8, PG II

US DOT ID NUMBER: UN1830

PROPER SHIPPING NAME: Sulfuric acid



MATERIAL SAFETY DATA SHEET

Sulfuric Acid

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA INVENTORY STATUS: Listed on the TSCA Inventory.

OTHER TSCA ISSUES: None.

SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

<u>INGREDIENT NAME</u>	<u>SARA/CERCLA RQ (lb)</u>	<u>SARA EHS TPQ (lb)</u>
Sulfuric acid	1000	1000

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: Immediate.

SARA 313 TOXIC CHEMICALS:

The following ingredients are SARA 313 "Toxic Chemicals" and may be subject to annual reporting requirements. CAS numbers and weight percents are found in Section 2.

<u>INGREDIENT NAME</u>	<u>COMMENT</u>
Sulfuric acid	None

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<u>INGREDIENT NAME</u>	<u>WEIGHT %</u>	<u>COMMENT</u>
No ingredients listed in this section.		

ADDITIONAL REGULATORY INFORMATION:

"Strong inorganic acid mists containing sulfuric acid" has been listed on California Proposition 65 as a cancer-causing agent.

WHMIS CLASSIFICATION (CANADA):

Listed on Canadian DSL and EU EINECS.

FOREIGN CHEMICAL CONTROL INVENTORY STATUS:

Listed on the Canadian DSL and EU EINECS.

16. OTHER INFORMATION

CURRENT ISSUE DATE: May, 2003



MATERIAL SAFETY DATA SHEET
Sulfuric Acid

PREVIOUS ISSUE DATE: November, 2001

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:

Addition of Prop 65 listing.

OTHER INFORMATION: None

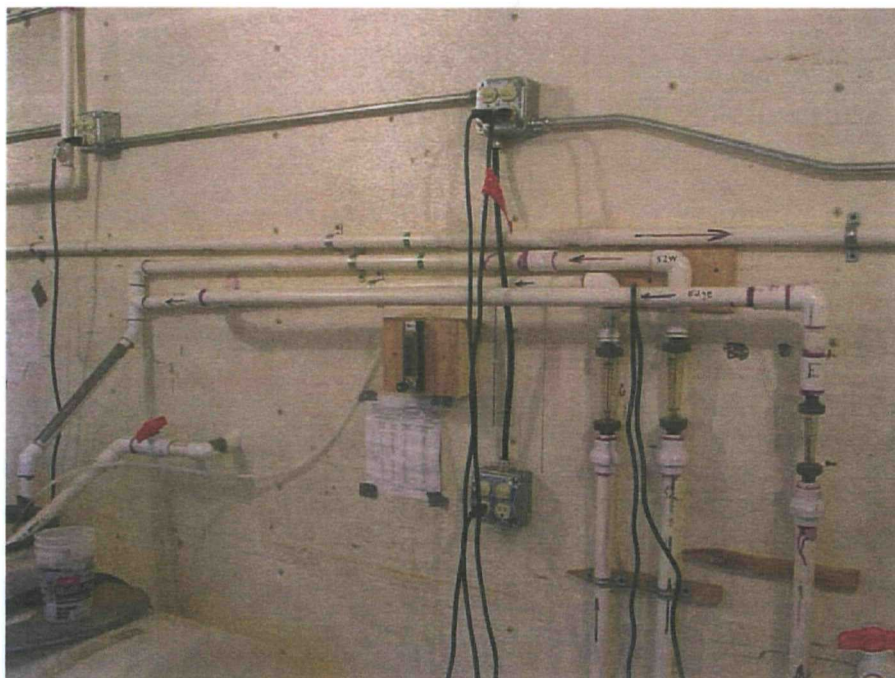
APPENDIX G



CMS Bay Harbor Development
NPDES Permit Application
Photographs



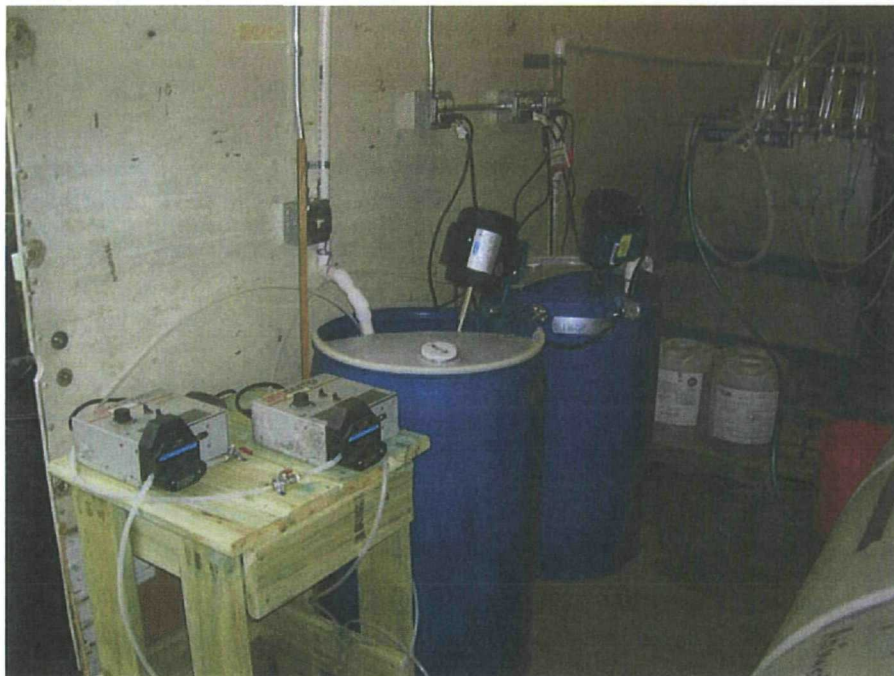
Photograph 1 – Four (4), 55-gallon head tanks, with associated plumbing, for storing influent prior to pH adjustment, coagulation/flocculation and ultrafiltration.



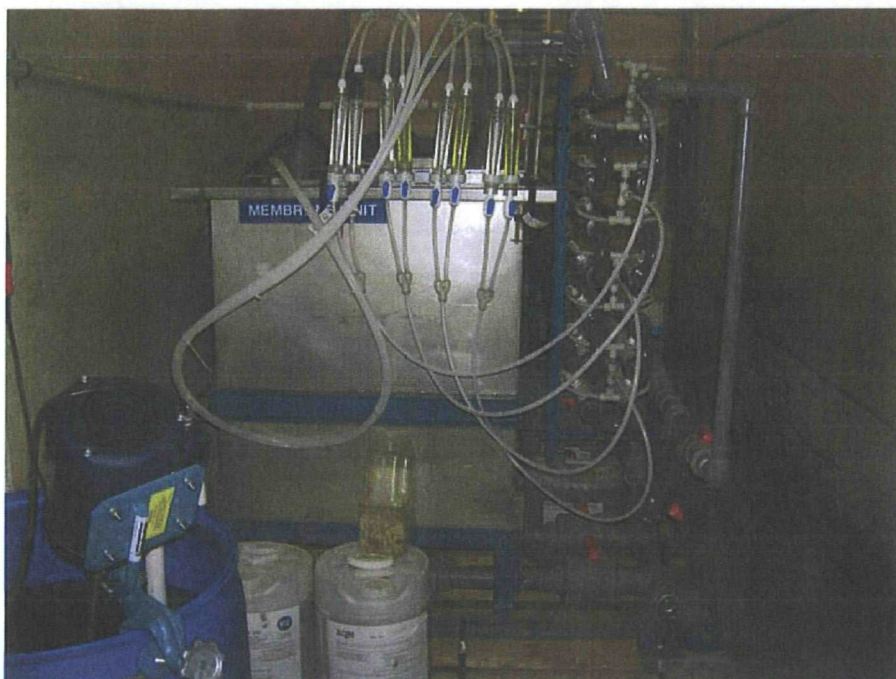
Photograph 2 – Flow meters and associated plumbing from the head tanks to the 300-gallon pH adjustment tank.



Photograph 3 – 300-gallon pH adjustment tank with mixer.



Photograph 4 – 55-gallon alum adjustment tank (left) and 55-gallon metal precipitant tank (right) with mixers. Aluminum sulfate (alum; Aquamark 120) is added in the alum adjustment tank and (Aquamark 131), a metal precipitant, is added in the right tank. Each tank has a 15-minute retention time.



Photograph 5 – Koch Membrane System tubular ultrafiltration pilot model UF 1x16.



Photograph 6 – Koch Membrane System's tubular membrane modules (16 total). There are two (2) different module types (8 of each type), each with slightly different filtration characteristics.



Photograph 7 – Influent feed lines from the Bay Harbor Pretreatment Facility to the pilot treatment system trailer. There is one (1) line for each of the four (4) influent streams (Seep 1, Seep 2W, Edge Drain and TLC). These lines feed each of the four (4) 55-gallon head tanks.



Photograph 8 – Two (2) 1,000-gallon waste tanks.